KOREA INTELLECTUAL PROPERTY OFFICE (KR)
PUBLIC PATENT GAZETTE (A)
PATENT APPLICATION NO. Tuk 1998-070192

Int. Cl.^{6}	H 04 N 5/52
Filing No.:	Tuk 1997-071366
Filing Date:	December 20, 1997
Publication Date:	October 26, 1998
Priority	
Date:	March 19, 1997
Country:	US
No.:	8/825.711
Date:	January 7, 1997
Country:	US
No.:	60/034.610

A RADIO RECEIVER WITH A SINGLE FIRST DETECTOR THAT DETECTS BOTH DIGITAL AND ANALOG TELEVISION RADIO FREQUENCY SIGNALS

Inventor:	Allen Leroy Limburg 416 Maetang-dong, Paltal-ku, Suwon City, Kyonggi Province
Applicant:	Chong Yong Yoon Samsung Electronics Co., Ltd.
Agent:	Kon Ju Lee 2500 Lake Vale Drive Vienna, VA 22181-4028 USA
Examination Request:	Filed

Abstract

A radio receiver that receives DTV (Digital TV) signals based on the ATSC (Advanced Television Sub-Committee) standard or analog TV signals based on the NTSC (National Television Systems Committee) standard uses one first detector for detecting both types of

signals. This single detector supplies its output signals to an intermediate frequency amplifier circuit for DTV signals and also to another intermediate frequency amplifier circuit for analog TV signals. The response of the IF (intermediate frequency) amplifier circuit to DTV signals are subjected to synchrodyning to a baseband and supplied to a symbol decoding circuit. It is used by the first automatic gain control circuit to develop AGC (Automatic Gain Control) for an amplifier stage within its IF amplifier circuit when DTV signals are received.

The response of the IF amplifier circuit to analog TV signals is supplied to a video detector, and the second automatic gain control circuit develops AGC for an amplifier stage within its IF amplifier circuit from the composite video signal regenerated by a video detector when analog TV signals are received. In some radio receivers the sound carrier of NTSC signals has an individual intermediate frequency amplifier circuit. When DTV signals are received, the absence of the 4.5 MHz intercarrier sound signal is determined to enable automatic fine adjustment at the first detector depending upon a pilot carrier and also to obtain any delayed AGC for a radio frequency amplifier from the first AGC circuit. When analog TV signals are received, the presence of the intercarrier sound signal is determined to enable automatic fine adjustment at the first detector depending upon a video carrier and also to obtain any delayed AGC for a radio frequency amplifier from the second AGC circuit.

<u>Brief Description of the Figures</u>

Representative Drawing

Figure 1

Specification

Figures 1-5 are embodiments of the radio receiver of the present invention as represented in block diagrams of the radio receiver part of a receiver for analog TV and digital TV.

Figure 6 is another embodiment of the present invention with a parallel IF amplifier for video and audio parts of NTSC analog TV signals and a modified block diagram of the radio receiver part in Figure 4.

Figure 7 is an embodiment of the present invention wherein video carrier and FM sound carrier components of NTSC analog TV signals are amplified by the UHF and VHF intermediate frequency amplifiers within pseudo-parallel arrangement and a modified block diagram of the radio receiver part in Figure 4.

Figure 8 is another embodiment of the present invention wherein video carrier and FM sound carrier components of NTSC analog TV signals are extracted from amplified DTV UHF

IF signals after down-conversion and amplified by the VHF intermediate frequency amplifier within pseudo-parallel arrangement and a modified block diagram of the radio receiver in Figure 4.

Figure 9 is a block diagram of the TV receiver in Figure 1 through Figure 5 and a remaining part of the TV receiver in Figure 4.

Detailed Explanation of the Invention

Objectives of the Invention

Field of the Invention and Prior Art

The present invention pertains to the radio receiver of a television (TV) signal receiver that receives US groundwave public television broadcasts whether the received signals are digital TV signals based on the ATSC (Advanced Television Sub-committee) standard or analog TV signals based on the NTSC (National Television Systems Committee) standard.

The first detector within a TV signal receiver converts radio frequency (RF) signals of one channel selected from TV broadcasting channels with various 6 MHz widths of the electromagnetic frequency spectrum into intermediate frequency (IF) signals with one specific 6 MHz width in the spectrum. In such conversions, RF signals are typically subjected to super-heterodyning, which may be considered as mixing RF signals are mixed with signals from a local oscillation that oscillates at essentially higher frequencies than the highest frequencies of TV signals. Amplification up to 60 dB or higher is fixed rather than variable tuning. The first detector is used to convert RF signals selected into IF signals so that it may be enabled within the specific 6 MHz width of the spectrum that uses an intermediate frequency amplifier. Amplification of received signals is needed to elevate the received signals to the power lever required for signal detection operation such as video detection and sound detection for analog TV signals and symbol decoding for digital TV signals. The first detector always includes variable tuning elements within an additional form of the element that determines frequencies of local oscillations that are used for super-heterodyning in the form of a pre-selected filter circuit and RF signals for RF signals that are selected among TV channels with variable 6 MHz width. In TV receivers of recent design, local oscillator signals are often generated by a frequency synthesizer that oscillates at a controlled frequency within what may be controlled as the fixed frequency of a standard oscillator.

The television signal receiver receiving digital television (DTV) signals that has been proposed by the conventional technology is a multiple conversion radio receiver. Here, DTV signals within one channel selected from UHF channels are subjected to upward frequency conversion to the first intermediate frequency signals of the first intermediate frequency band that is centered at 920 MHz for amplification of the first intermediate frequency amplifier.

Consequently, the first intermediate frequency signals amplified are subjected to down-conversion by mixing with 876 MHz local oscillation signals and eventually become the second intermediate frequency signals. Next, the second intermediate frequency signals of the second intermediate frequency band that is centered at 44 MHz are amplified at the second intermediate frequency amplifier. Next, response of the second intermediate frequency amplifier becomes subjected to synchrodyning to the baseband of a DTV signal receiver that has been developed by the Grand Agreement.

The radio receiver receiving DTV signals whose final intermediate frequency signals exist somewhere within this frequency range of 1 to 8 MHz was disclosed by C. B. Patel and the inventor of US Patent No. 5,479,449 registered on December 26, 1995 entitled "Digital VSB Detector with Bandpass Phase Tracker, for Inclusion in an HDTV Receiver" and included in its citation document. The radio receiver described in detail in the US Patent No. 5,479,449 is in the form of 3-step conversion wherein a 920 MHz analog IF amplifier for the first detector response, the first detector of an up-converter, a 44 MHz analog IF amplifier for the second detector output, and the second detector of a down-converter are employed. The third detector is another down-converter and generates 1-8 MHz final IF signals as the third detector output. Such final IF signals are not amplified but are digitized by an analog/digital converter so that they may used within a digital circuit for synchrodyning to a baseband. Subsequent digital baseband signals are equalized and then subjected to data separation within a symbol decoder. The first intermediate frequency amplifier within one receiver out of plural DTV signal receivers that were disclosed in US Patent No. 5,479,449 employs a surface acoustic wave (SAW) filter to establish a bandwidth of a 920 MHz IF amplifier.

The DTV signal receiver developed by the Grand Agreement is in the form of 2-step conversion wherein a 920 MHz analog IF amplifier for the first detector response, the first detector of an up-converter, a 44 MHz analog IF amplifier for the second detector response, and the second detector of a down-converter are employed. Since amplification response of a 44 MHz analog IF amplifier is the final IF signal, this becomes subjected to synchrodyning to a baseband within the analog system. The resulting analog baseband response is digitized by an analog/digital converter before being equalized, and then subjected to data separation within a symbol decoder. The first intermediate frequency amplifier of the DTV signal receiver developed by the Grand Agreement employs a ceramic resonator to establish the bandwidth for a 920 MHz IF amplifier.

Although DTV broadcasting has been deployed for a number of years, the broadcasting of analog TV signals is scheduled to continue in the US in compliance with the NTSC standard that employs identical UHF channels as DTV signals and with other channels within VHF and UHF bands. While analog and digital TV signals use identical TV channels, the requirements for

a radio receiver for both types of TV signals are not particularly compatible. Therefore, there exists sufficient reason to employ a radio receiver that can separately process analog TV signals and digital TV signals in a system designed to receive both types of TV signals.

The reason, as is clear to an electronic design engineer who must comply with system standards for both types of TV signals, that the radio receiver must separately process analog TV signals and digital TV signals is related to the passbands of a radio receiver that are different for each type of TV signal. For analog TV signals, a video carrier is located at the frequency 1.25 MHz that exceeds the much lower limiting frequency of a TV channel. A vestigial sideband does not show gain decrease compared with a sideband until its modulation frequency exceeds 750 KHz. Therefore, a radio receiver for analog TV signals usually exhibits linear roll-off for the overall intermediate frequency response supplied to a video detector. Roll-off drops down at a video carrier frequency by 6 dB and supplies to overall flat baseband video response within 4.2 MHz. For DTV signals data are located only at the frequency 310 KHz that exceeds much lower limiting frequency of a TV channel. In addition, the 6 dB roll-off down at a data carrier frequency is supplied to a transmitter rather than a receiver. Overall intermediate frequency response is practically flat for the frequency band of 6 MHz width in the 1 dB-down limiting frequency of the Grand Agreement receiver design that was declared by Zenith Radio Corporation.

A radio receiver for analog TV signals usually employs a trap filter to eliminate a frequency modulation (FM) sound carrier from the IF signal applied to a video detector. This is needed to suppress the 920 KHz bit between the FM sound carrier and the amplitude modulation chromaticity subcarrier. The bit causes undesirable deviation in the luminance component of the composite video signal restored by a video detector. Such luminance variation becomes more apparent when displayed on a TV screen. Although a co-channel that interferes with NTSC signals is a known problem during HDTV reception, a sound trap filter has not been employed in designing DTV receivers of conventional technology. Avoidance of trap filtering in the IF amplifier for DTV signals makes it easy to maintain phase linearity over the entire IF passband.

In the design technology for one type of such a radio receiver, a reason that may not be recognized or a more subtle reason why a radio receiver separated for analog TV signals and digital TV signals is employed lies in the difference in desirable designs of automatic gain control (AGC) for the radio receiver part of an analog TV signal receiver and a DTV signal receiver.

In order for the accompanying Johnson or galactic noise not to become a source of distortion to the human eye in a black-and-white TV picture (brightness noise) or a color TV picture (brightness plus chromaticity noise), the transmitting power must be sufficiently high for analog TV signals so that the amplification can be kept sufficiently low. Effective discharge

power from an analog TV transmitter is typically tens of kilowatts. As the IF amplifier circuit of an analog TV signal receiver typically provides a maximum gain of 60 to 90 dB, such a gain may be reduced depending upon the automatic gain control (AGC). A reduction in gain of about 66 dB is required to control the entire signal strength available. When analog TV signals are received, such a gain reduction obtains forward AGC utilization within the IF amplifier stage at least initially. Compared with the Johnson noise that negatively influences the overall noise value in a radio receiver, such a gain reduction avoids the noise problem taking place within an IF amplifier stage. Its problem results from employing reverse AGC. Because the human eye is very sensitive to random noise that accompanies composite video signals of a video detector, a significant problem of loss in noise values results from receiving analog TV signals. The magnitude of a luminance signal component in composite video signals directly controls the intensity of radiated or reflected light from a television display. The magnitude of chromaticity signal component in composite video signals directly influences hue and color saturation.

In a DTV receiver, its radio receiver part supplies numerous level symbol codes as baseband output signals, and the light emitted by or reflected from a television display is directly adjusted by the magnitude of such baseband output signal. A small quantity of random noise is strongly rejected by quantization effect within trellis decoding that is related to data slicing and symbol decoding. Therefore, the overall noise value of a radio receiver usually becomes a problem mostly when the various levels of a symbol code are differentiated. The linearity of the baseband output signal detected by a radio receiver to help differentiate the various levels of a symbol code becomes an important issue. As long as DTV signals for long-distance reception are not transmitted at a power level of several hundred watts, the overall noise value of a radio receiver will not cause any problems.

It is evident in a DTV signal receiver that AGC of an IF amplifier stage avoids nonlinearity. Forward AGC tends to introduce nonlinearities into the modulation of IF signals. Because much larger amplitude modulation appropriately takes place mostly during synchronizing pulses and because luminance signals vary with picture brightness in an inverse algebraic relationship, the resulting distortion is generally tolerated in reception of analog TV signals. Reverse AGC that does not introduce nonlinearities into the modulation of IF signals may be designed for a DTV signal receiver. Such a design, for example, may be achieved by employing variable resistor emitter degeneration within a common emitter transistor amplifier. In another example, the collector current of a common emitter transistor amplifier may be divided by a common base transistor amplifier connected to an emitter electrode so that a variable transconductance amplifier may be formed. In such reverse AGC arrangement any loss in noise values with gain reduction does not cause problems as long as the overall noise internally

generated within the IF amplifier circuit of a DTV receiver is much less than the minimum change among digital modulation levels within the final IF amplifier output signals.

The present inventor is of the opinion that the utilization of separate first detectors for analog TV signals and digital TV signals in a radio receiver that is designed to receive both types of signals is undesirable and that a single detector is practical and sufficient, whether the cost of such a first detector is included in a TV set whose radio receiver has a viewing screen or in a digital recording device such as magnetic tape. Utilization of one detector for both analog TV signals and digital TV signals enables more compact a design of radio receivers. At the same time, it is also desirable in that any problems of unwanted radiation from any output of either at the separated first detectors for analog TV signals or digital TV signals, respectively, to the other first detector, are avoided.

Technical Objectives of the Invention

A radio receiver that receives both DTV signals based on the ATSC standard and analog TV signals based on the NTSC standard embodies key aspects of the present invention by employing one first detector for both types of signals, but has a separate layout that amplifies a single first detector output for each type of signals. This single first detector supplies its output signals to the intermediate frequency amplifier circuit for DTV signals and also to another intermediate frequency amplifier circuit for analog TV signals. The response of the IF amplifier circuit to DTV signals is synchrodyned to a baseband and supplied to a symbol decoding circuit. The output of the intermediate frequency amplifier to analog TV signals is supplied to a video detector. It is desirable that the IF amplifier circuit for DTV signals employs an amplifier stage that maintains the gain linearity and belongs to reverse AGC in despite the gain reduction. On the other hand, the IF amplifier circuit for analog TV signals employs, at least initially, an amplifier stage that maintains good noise values and belongs to forward AGC despite the gain reduction. For the receiver configured in accordance with the application of the present invention, a radio frequency amplifier of the first detector front-end that overloads the first mixer in the first detector of [illegible] is avoided by delayed reverse AGC of an RF amplifier.

In addition, as to another aspect of a radio receiver that embodies key aspects of the invention, a video carrier or pilot carrier that is extracted from the intermediate frequency amplifier circuit for DTV signals is used for the AFT of a single first detector.

In addition, as to another aspect of a radio receiver that embodies key aspects of the invention, a video carrier extracted from the intermediate frequency amplifier circuit for DTV signals is used to calculate intercarrier sound intermediate frequency signals from the output of the intermediate frequency amplifier circuit for analog TV signals.

In addition, as to another aspect of a radio receiver that embodies key aspects of the invention, the intermediate frequency amplifier circuit for DTV signals and the intermediate frequency amplifier circuit for analog TV signals respectively includes a mixer with oscillation from a divided second local oscillator that synchrodynes the first amplified detector output.

Constitution and Operation of the Invention

Figure 1 illustrates the radio receiver part of a television receiver that is able to receive either analog signals or digital TV signals. An antenna (0) is the representative source of VHF and UHF band television signals supplied to a radio frequency (RF) amplifier (1). RF amplifier (1): the RF amplifier (1) is supplied to a tracking pre-selected filter that is used to select one of the television broadcast bands in which the television signals selected for reception exist. The RF amplifier (1) supplies amplified output of the television signals that are selected for reception at the first detector (2). The first detector (2) includes the first local oscillator that performs automatic fine adjustment, a frequency synthesizer that generates super-heterodyning signals with the frequency of the first local oscillator within a selected ratio, the first mixer that mixes the selected signal to generate UHF intermediate frequency signals with super-heterodyning signals, and a front-end filter that suppresses images of the IF signal of the output signal that has been supplied from the first mixer. The first mixer is desirable in terms of form. The first detector (2) transmits selected radio frequency signals of 6 MHz in width so that a center may be nominally established in the ultra-high frequency that exceeds the UHF band part comprising an established television broadcast channel, and deploys a selected image frequency greatly exceeding 1 GHz so that it may be easily extracted by a bandpass coupling network. For example, the first detector (2) may be similar to the conventional first detectors in the multiple conversion digital HDTV receivers used in the Grand Agreement during its field tests of HDTV (High Definition Digital Television) that complied with the ATSC standard and the UHF IF signals with its center frequency at 920 MHz.

In particular, the right part of the radio receiver for digital TV signals in Figure 1 may be similar to those receivers disclosed in US Patent No. 5,479,449. UHF IF signals supplied from the first detector (2) pass through a buffer amplifier (3) and are applied to the SAW (surface acoustic wave) filter (4) with a bandwidth of -1dB to -1dB at 5.7-6.0 MHz that has essentially linear phase and a flat amplitude response. The buffer amplifier (3) provides fixed gain to give an insertion loss of 10-12 dB for the SAW filter (surface acoustic wave filter) (4) and drives the SAW filter (4) from a selected fixed-source impedance to avoid unwanted reflection. The output of the SAW filter (4) and the UHF local oscillation from the second local oscillator (5) are respectively supplied to the second mixer (6) as the first and second input signals so that the first

VHF intermediate frequency signals may be generated and that SAW filter (4) output may be down-converted.

In particular, the left part of the radio receiver for digital TV signals in Figure 1 includes a buffer amplifier (7) that applies UHF IF signals supplied from the first detector (2) to the SAW filter (8) that essentially has linear phase response with a bandwidth exceeding 6 MHz. However, its video carrier exhibits roll-off at the frequency of UHF IF signals transmitted by the first detector (2) and at higher frequencies whose gain has been lowered by 6 dB. Such a roll-off makes suppression of the bit between a video carrier and a sound carrier of the next adjacent TV channel simple. The buffer amplifier (7) provides fixed gain to give an insertion loss of 10-12 dB for the SAW filter (8), and drives the SAW filter (8) from a selected fixed-source impedance to avoid unwanted reflection. Buffer amplifier (3,7) is configured as a common source amplifier and prevents certain interaction between SAW filters (4,8) that results from direct driving by the first detector (2). The output of the SAW filter (8) and local oscillation from the second local oscillator (5) are respectively applied to the second mixer (9) as first and second input signals that down-convert the SAW filter (8) output so that the second VHF intermediate frequency signals may be generated.

The second mixers (6,9) are well designed. The second local oscillator (5) and the second mixer (6) provide the first down-converter that down-converts the ultra high frequency intermediate frequency signals amplified first from the first UHF IF amplifier that has been formed by series connection of the buffer amplifier (3) and the SAW filter (4) so that output of the first down-converter may be generated. The second local oscillator (5) and the second mixer (9) provide the second down-converter that down-converts the ultra-high frequency intermediate frequency signals amplified second from the second UHF IF amplifier that has been formed by series connection of the buffer amplifier (7) and the SAW filter (8) so that response from the second down-converter may be generated.

In addition to the buffer amplifier (3), SAW filter (4) and second mixer (6), the IF amplifier circuit for DTV signals includes the first VHF IF amplifier that has been formed by series connection of a SAW filter (10) and a broadband intermediate frequency amplifier (11). The SAW filter (10) has essentially linear phase and flat amplitude response with its bandwidth exceeding 6 MHz, and supplies the frequency-selective response of the amplifier (11) to the first VHF IF signal of the second mixer (6). The mixer (6) is designed to avoid unwanted reflection so that output impedance may provide its optimal source impedance to the SAW filter (10). The response of the SAW filter (10) is amplified by the amplifier (11) that provides reverse AGC. The VHF IF signal amplified first by the IF amplifier (11) is synchrodyned to a baseband by a synchrodyning circuit (12), and the resulting common (or actual) baseband signals equalized by an equalizer circuit (13). The equalized common baseband signal is supplied to a symbol decoder

(14). The symbol decoder (14) performs data separation operation on the equalized baseband signal to restore data that has been supplied to a trellis decoder in a HDTV receiver (not shown in Figure 1).

The common baseband signal from the synchrodyning circuit (12) generates AGC signals to control the gains of the stages in the IF amplifier (11), and is supplied to the delayed automatic gain control circuit (15) that generates delayed AGC signals to control the gain of the RF amplifier (1) during DTV signal reception. The AGC circuitry (15) may have any of several known designs. In the initial receivers of the Grand Agreement, an AGC circuitry for DTV signals uses filters that correspond to data segment code groups. The output of such corresponding filters are peaks used to develop the basic AGC circuit that have been used to develop the delayed AGC for an IF amplifier stage. AGC that reacts to average symbol values may be used according to US Patent No. 5,565,932 entitled "AGC System with Pilot Using Digital Data Reference" disclosed by Citta et al. In US Patent Application No. 01/573,454 entitled "Automatic Gain Control of Radio Receiver for Receiving Digital High-Definition Television Signals" that was filed by C. B. Patel and the present inventor on December 15, 1995 and later granted, an AGC circuit is disclosed that detects direct components of the baseband signals generated by synchrodyning a pilot carrier to a baseband during DTV signal reception. A more desirable AGC circuit designed by the present inventor is a modification of the AGC circuit disclosed in US Patent Application No. 01/573,454. This modification depends upon envelope detection of the IF amplifier (11) to develop AGC during analog TV signal reception. This interferes with such operation that the IF amplifier (11) accompanies excessive gain during analog TV signal reception so that video carrier signals may be extracted from the output of the IF amplifier (11).

US Patent No. 5,479,449 discloses a synchrodyning circuit (12) comprising a circuit in which the second IF signal is converted into a final IF signal somewhere within the band of 1 to 8 MHz, an analog/digital converter that digitizes the final IF signal, and a digital circuit that performs synchrodyning to a baseband in digital mode. As with the receiver used for HDTV field tests by the Grand Agreement, the synchrodyning circuit (12) may operate in analog mode based on analog baseband signals that have been digitized by an analog/digital converter to apply to an equalizer circuit (13). The equalizer circuit (13) is connected to a phase tracker in series that operates at a baseband.

In addition to the buffer amplifier (7), SAW filter (8) and second mixer (9), the IF amplifier circuit for analog TV signals includes the second VHF IF amplifier that is formed by series connection of a SAW filter (16) and a broadband intermediate frequency amplifier (17). The SAW filter (16) essentially has both linear phase with its bandwidth exceeding 6 MHz and a flat amplitude response, and supplies frequency selective response of the amplifier (17) to the

first VHF IF signal from the second mixer (9). The SAW filter (16) may be designed exactly like the SAW filter (10), and the second mixers (6,9) may be considered to use the second local oscillation at the same frequency. To avoid unwanted reflection, the mixer (9) is designed so that its output impedance may be supplied to the SAW filter (16) as an optional input impedance. Response of the SAW filter (16) is amplified by the amplifier (17) as one of initial stages with forward AGC. To provide the AGC area required by commercial television receivers, it is also evident that AGC must be prepared for one of the back ends. In an analog TV design AGC of the back end of the amplifier (17) may be forward AGC or reverse AGC depending upon standard practice.

The second VHF intermediate frequency signal amplified from the IF amplifier (17) passes through the buffer amplifier (18) and is supplied to the SAW filter (19) that catches an FM sound carrier to interfere with 920 kHz bit with a chrominance subcarrier within a composite video signal that has been detected by the video detector (20) to which the output of the SAW filter (19) has been supplied. The buffer amplifier (18) provides a fixed gain to give an insertion loss of 15-17 dB for the SAW filter (19) and drives the SAW filter (19) from a selected fixed-source impedance to avoid unwanted reflection.

The composite video signal detected by a video detector (20) is supplied to an automatic gain control circuit (21) that generates the AGC signal that controls the gains of stages within the IF amplifier (17) and the delayed AGC signal that controls gain of the RF amplifier (1) during analog TV signal reception. The video detector (20) may either a synchronous detector or an envelope detector. In addition, the video detector (20) may comprise a synchronous detector that supplies composite video signals to a luminance and chromaticity separator circuit of a receiver and further comprises an envelope detector that supplies composite video signals to the AGC circuit (21) and the synchronizing separator circuit. In general, a synchronous detector is more linear than an envelope detector and better suppresses Johnson noise. As long as a majority of TV broadcasting is carried out in NTSC mode, the high cost of a synchronous detector is naturally expected. Since the AGC circuit (21) follows common designs for analog TV receivers, such designs allows detection of amplitudes peaks in horizontal synchronizing pulses so that AGC signals may be typically generated.

The third intermediate frequency signal amplified from the IF amplifier (17) is supplied to a SAW filter (23) via a buffer amplifier (22). To avoid unwanted reflections, the buffer amplifier (22) drives the SAW filter (21) from fixed-source impedance. The buffer amplifiers (18,22) configured in common source mode, prevent certain interaction between the SAW filters (19,23) that are directly driven by the IF amplifier (17) for generation. When NTSC analog TV signals are received, the SAW filter (23) selects an FM sound carrier of the signal (transmitted as VHF intermediate frequency) that is applied to the third mixer (24) as the first input signal. The

mixer (24) receives the output from a narrowband bandpass filter (25) as the second input signal. The filter (25) supplies a video carrier (transmitted as VHF intermediate frequency) depending upon the first VHF IF signal output that has been amplified by the VHF IF amplifier (11). When NTSC analog TV signals are received, the output signal from the mixer (24) is a frequency-modulated 4.5 MHz intercarrier. When NTSC analog TV signals are received, the output signal from a mixer (24) is noise. The output signal from the mixer (24) is amplified within the high-gain sound IF amplifier (26) designed to allow amplification only if the frequency-modulated 4.5 MHz intercarrier exists within its signal. Since the response of the sound IF amplifier (26) is supplied to a frequency discriminator or frequency modulation detector (27), this regenerates an NTSC composite sound signal. This NTSC composite sound signal is a baseband signal including a main channel component that is a left-plus-right signal during sound transmission of stereophonic sound. During sound transmission of stereophonic sound the NTSC composite sound signal includes a subcarrier of stereophonic sound that has been amplitude-modulated by a left-minus-right signal. The NTSC composite sound signal also includes another subcarrier that has been modulated by support audio program(s).

A person skilled in the art of designing analog TV receivers understands that the SAW filter (19) is merely an example, and that it may be replaced by other types of sound trap filters, such as bridge-T. Here, other types of sound trap filters are thought to be alternatives to the SAW filter (19) within the scope of the invention. A person skilled in the art of designing analog TV receivers also understands that the SAW filter (23) is merely an example, and that it may be replaced with other types of sound IF selection filters such as a dual-tuned transformer. Here, other types of sound IF selection filters are thought to be alternatives to the SAW filter (23) within the scope of the invention.

Whether NTSC analog TV signals are intended or result from crosstalk with a strong co-channel during DTV signal reception, the fact that the frequency modulated signal of 4.5 MHz intercarrier is present within the output signal from the mixer (24) only if reception is for one of the reasons mentioned above is utilized for the circuit in Figure 1 to develop NTSC/ATSC control signals. Since the amplified mixer (24) output signal is supplied from the sound IF amplifier (26) to the intercarrier amplitude detector (28), it detects average amplitudes of the 4.5 MHz intercarrier. For example, the intercarrier amplitude detector (28) may be a simple envelope detector with time constants equal to several NTSC scanning lines. As baseband response of the amplitude detector (28) is supplied to the threshold detector (29), this generates NTSC/ATSC control signals as output signals. If the intercarrier signal detected exceeds its amplitude limit, the threshold detector (29) provides signs for the existence of NTSC signal reception. Otherwise, if there is no clear co-channel interference, it provides signs for the existence of DTV signal reception.

When DTV signals are received, the coding of a baseband symbol restored by the synchrodyne circuit (12) is probably achieved by the direct component generated from synchronous detection by a pilot carrier. This direct component may be detected to verify DTV signal reception. Once DTV signal reception is verified, DTV signal reception with interference by a clear co-channel is indicated. However, the threshold detector (29) provides signs of the presence of NTSC signal reception.

The inventor points out that it is desirable that the SAW filter (4) suppresses a frequency-modulated NTSC sound carrier and that it has essentially linear phase and flat amplitude response that appropriately has a bandwidth of -1 dB to -1 dB at 5.7 MHz. As this allows utilization of a more desirable form of the symbol decoder (14), such desirable form optionally employs a comb filter that additionally combines symbols suppressing NTSC co-channel interference. This form of the symbol decoder (14) is disclosed in US Patent Application No. 0/746,520 entitled "Digital Television Receiver with Adaptive Filter Circuitry for Suppressing Co-Channel Interference" applied on November 12, 1996 and embodied by its references. As the end part of the SAW filter (4) response is very accurately located within a frequency spectrum, automatic fine tuning (AFT) of the first local oscillator in the first detector (2) becomes an actual requirement. The second local oscillator (5) becomes transparently stabilized. Thus, the first VHF IF signal amplified from the VHF IF amplifier (11) may be used for AFT during DTV signal reception. The fact that responses of the SAW filters (4,10) are flat in terms of amplitude and linear in terms of phase at the end of the band at which the pilot carrier of DTV signals and the video carrier of NTSC analog TV signals are located makes the first VHF IF signal an appropriate signal source for generating AFT signals whether TV signals being received are DTV signals or analog TV signals.

When DTV signals are received, the narrow bandpass filter (30) transmits to the VHF intermediate frequency within the first VHF IF signal that has been amplified from the VHF IF amplifier (11), but selects the AFT detector (31) pilot carrier. A common structure of the AFT detector (31) is similar to those of conventional ones used in analog TV signal receivers. Thus, it typically includes a limiter amplifier for passband filter response that is received as an input signal, a phase shifter that shifts a pilot carrier by 90° upon being established at a VHF intermediate frequency, a multiplier that multiplies pilot carriers with each other whose phases have been essentially shifted, and a low-pass filter that extracts AFT signals from the outcome.

When analog TV signals are received, the narrow bandpass filter (25) transmits to the VHF intermediate frequency within the first VHF IF signal that has been amplified from the VHF IF amplifier (11), but selects the AFT detector (32) video carrier. Common structures of the AFT detector (32) are similar to those of conventional ones used in analog TV signal receivers. Thus, it typically includes a limiter amplifier for passband filter response that is received as input

signal, a phase shifter that shifts a pilot carrier by 90° upon being established at a VHF intermediate frequency, a multiplier that multiplies pilot carriers with each other whose phases have been essentially shifted, and a low-pass filter that extracts AFT signals from the outcome.

The AFT selector (33) selects an AFT signal to apply from the AFT detector (32) to the first local oscillator within the first detector (2) when the NTSC/ATSC control signal supplied form the threshold detector (29) indicates that analog TV signals of substantial intensity are being received. The AFT selector (33) selects an AFT signal to apply from the AFT detector (31) to the first local oscillator within the first detector (2) when the NTSC/ATSC control signal does not indicate that analog TV signals of substantial intensity are being received.

The AGC selector (34) selects a delayed AGC signal to apply from the AGC (21) to the radio frequency amplifier (1) when the NTSC/ATSC control signal supplied from the threshold detector (29) indicates that analog TV signals of substantial intensity are being received. The AGC selector (34) selects a delayed AGC signal to apply from the AGC detector (15) to the RF amplifier (1) when the NTSC/ATSC control signal does not indicate that analog TV signals of substantial intensity are received. Optionally, the gain of the RF amplifier (1) may be reduced by much more delayed AGC signals respectively supplied by AGC detectors (15,21) that are discriminated by an analog OR circuit rather than by using the AGC selector (34) depending upon the NTSC/ATSC control signal supplied from the threshold detector (29). Because the gain of the radio frequency amplifier (1) is reduced by much higher RF frequencies, the gain reduction method accompanied by certain loss in noise values may be tolerated without making analog TV reception too noisy. Therefore, reverse AGC is desirably provided with an RF amplifier so that gain linearity for DTV reception may be better maintained.

Figure 2 illustrates a radio receiver part that receives analog TV and digital TV signals. The radio receiver part is different from that in Figure 1 in the following aspects. As for the gain of a video carrier (transmitted as UHF intermediate frequency), the SAW filter (8) with roll-off of -6 dB may be provided by a SAW filter or is replaced with an adjacent channel trap filtering (35) that may be configured with an inductor or a capacitor. The SAW filter (19) that has sound carrier rejection except for flat amplitude response at the other end of a VHF IF band is replaced with a video SAW filter that provides -6 dB roll-off, not only in the FM sound carrier rejection that is transmitted as a VHF intermediate frequency, but also in the overall IF gain on the video carrier that is transmitted as VHF intermediate frequency. An example of the SAW filter that exhibits a form of response to both the video carrier transmitted as 47.75 MHz and the sound carrier transmitted as 41.25 MHz is SAF45MVB80Z manufactured by Murata Manufacturing Co. Ltd. in Erie, Pennsylvania.

Figure 3 illustrates a modification of the radio receiver part in Figure 2, wherein the second VHF IF signal amplified and supplied by the VHF IF amplifier (17) is supplied to the

band pass filter (25) used to select a video carrier as an input signal rather than to the band pass filter (25) that receives the first VHF IF signal amplified and supplied by the VHF IF amplifier (11) as an input signal. Because the adjacent channel trap filtering (35) does not exhibit roll-off in the gain on a video carrier (transmitted as an UHF intermediate frequency), there is no roll-off in the gain on the video carrier (transmitted as a VHF intermediate frequency) within the second VHF IF signal that has been amplified and supplied by the VHF IF amplifier (17). This is appropriate to develop AFT signals during analog TV reception. The AGC form applied to the VHF IF amplifier (17) makes the second amplified VHF IF signal somewhat better for AFT purposes than the first VHF IF signal that has been amplified and supplied from the VHF IF amplifier (11).

Figure 4 illustrates modification of the radio receiver part in Figure 2 of a TV receiver. This modification provides in part the parallel IF amplifier circuit for both modulation of an NTSC video carrier and modulation of an NTSC audio carrier. The second mixer (9) is replaced with two second mixers (37,38), and the VHF IF amplifier (17) and buffer amplifiers (18,22) are replaced with two VHF IF amplifiers (39, 40) whose individual configuration is similar to each of the buffer amplifiers. A form of doubly-balanced linear-multiplication is desirable for each of the two second mixers (37,38), and they are designed to drive SAW filters (36,23) from the source impedance that minimizes various reflections. In order for the second local oscillator (5) and the second mixer (37) to generate the second VHF down-converter response that has been supplied to the SAW filter (36) as an input signal, the second down-converter is provided wherein the second ultra-high frequency intermediate frequency signal amplified from the UHF IF amplifier that has been formed by series connection of the buffer amplifier (7) and the adjacent channel trap filtering (35) is down-converted. In order for the second local oscillator (5) and the second mixer (38) to generate the third VHF down-converter response that has been supplied to the SAW filter (23) as an input signal, the third down-converter is provided, wherein the second ultra-high frequency intermediate frequency signal amplified from the second UHF IF amplifier is down-converted. The VHF IF amplifier (39) amplifies the response of the SAW filter (36) as NTSC audio carrier modulation to apply to the video detector (20), while the VHF IF amplifier (40) amplifies the response of the SAW filter (23) as NTSC audio carrier modulation to apply to the third mixer (24). VHF IF amplifiers (39,40) become subjected to the automatic gain control signal that is accompanied with the AGC circuitry (21) so that each of their gains may be mutually followed.

Figure 5 illustrates modification of the radio receiver part of the TV receiver in Figure 4. In this modification the second VHF IF signal amplified that has been supplied by the VHF IF amplifier (17) is supplied as an input signal to the bandpass filter (25) used to select a video carrier rather than to the band pass filter (25) receiving the first VHF IF signal amplified as an

input signal that has been supplied by the VHF IF amplifier (11). Because the adjacent channel trap filtering (35) does not exhibit roll-off in the gain on a video carrier (transmitted as an UHF intermediate frequency), there is no roll-off in the gain on the video carrier (transmitted as a VHF intermediate frequency) within the second VHF IF signal that has been amplified and supplied by the VHF IF amplifier (17). This is appropriate to develop AFT signals during analog TV reception. The AGC form applied to the VHF IF amplifier (17) makes the second VHF IF signal amplified that is somewhat better for AFT purposes than the first VHF IF signal that has been amplified and supplied from the VHF IF amplifier (11).

Figure 6 illustrates the modification of the radio receiver part of the TV receiver in Figure 4. This modification ideally provides the parallel IF amplifier for modulation of an NTSC video carrier and for modulation of an NTSC audio carrier. The buffer amplifier (7) and the adjacent channel trap filtering (35) have been removed. Instead, the second mixer (37) receives the first input signal from series connection of the buffer amplifier (41) and the SAW filter (42), whereas the second mixer (38) receives the first input signal from series connection of the buffer amplifier (44) and the SAW filter (45). The SAW filter (36) within a VHF IF band is no longer present but replaced with the SAW filter (43) so that the influence on the overall IF bandwidth may not be significant. It has flat amplitude and linear phase response that amounts to at least 6 MHz of a bandwidth.

The overall IF bandwidth for NTSC video modulation is determined by the SAW filter (42), which introduces -6 dB roll-off of the video carrier that is required to replaces the adjacent channel trap filtering (35) and equalize the video response from the video detector (20). The UHF IF signal supplied from the first detector (2) provides fixed gain to give an insertion loss of 10-12 dB for the SAW filter (42), and passes through the buffer amplifier (41) that drives the SAW filter (42) from a selected fixed-source impedance and applies to the SAW filter (42) to avoid unwanted reflections. The SAW filter (42) is different from the SAW filter (8) in Figure 1 in that it has not only an adjacent channel sound trap but also an in-channel sound trap. Since the SAW filter (42) has essentially linear phase response with a bandwidth of 5.5 MHz or more, it exhibits amplitude roll-off near the frequency of a video carrier so that the response with the gain at 6 dB down may be provided in the frequency within the UHF IF signal at which a video carrier is transmitted by the first detector (2).

As far as the NTSC audio carrier modulation is concerned, the SAW filter (45) separates frequencies within an UHF IF band including an FM sound carrier to apply to the second mixer (38). The UHF IF signal supplied from the first detector (2) is applied to the SAW filter (45) via a buffer amplifier (44). The buffer amplifier (44) provides fixed gain to give an insertion loss for the SAW filter (45), and drives the SAW filter (45) from a selected fixed-source impedance to avoid unwanted reflections.

Figure 7 illustrates modification of the radio receiver part of the TV receiver in Figure 6. In this modification the sound component of an NTSC analog TV signal is amplified by IF amplifiers within the so called pseudo-parallel arrangement. The SAW filter (45) for the FM sound carrier component within an UHF IF band is replaced with the SAW filter (47) that has a double-humped response among NTSC audio carriers, NTSC video carriers transmitted to the UHF IF band, and humps. Its magnitude is at least 10 dB and may reach the peak. The UHF IF signal supplied from the first detector (2) provides fixed gain to make insertion loss of 10 to 12 dB for the SAW filter (47), and passes through the buffer amplifier (44) that drives the SAW filter (47) from a selected source-impedance and applies to the SAW filter (47) to avoid unwanted reflections. (Verify reference symbols from line 11 to line 14 on page 20 of the original before translation)[sic]. The third mixer (24) is replaced with a nonlinear device such as a rectifier within a simple envelope detector that operates as an intercarrier sound detector (48), which generates an intercarrier input signal for the 4.5 MHz sound IF amplifier (26).

Figure 8 illustrates a modification of the radio receiver part of the TV receiver in Figure 7. In this modification both the SAW filter (46) and the SAW filter (47) with double-humped response within the UHF IF band no longer exist. Instead, the second mixer (38) is supplied with the first UHF IF signal amplified from the SAW filter (4), while the SAW filter (46) is replaced with the SAW filter (49) that has double humped response within the VHF IF band. In other words, the SAW filter (49) has a double-humped response that reaches at least a 10 dB down peak as to the response among NTSC audio carrier, NTSC video carrier transmitted to the UHF IF band, and humps.

When the modifications in Figure 7 and Figure 8 are used, it is not necessary to extract a video carrier from the response of the IF amplifier (11) during analog TV signal reception. Thus, when DTV signals are not being received, no particular need exists such that the IF amplifier (11) may not be operated with excessive gain. This allows simplification of the AGC circuitry (15) because it is not necessary to depend upon envelope detection of the IF amplifier (11) output to develop AGC when DTV signals are not being received.

For the radio receiver part disclosed in detail in Figure 1 through Figure 8, the IF amplifier for the UHF IF band has fixed rather than adjustable gain. In addition, such fixed gain is mainly used to suppress insertion losses of continuous SAW filters in amplifiers. As for suppressing image rejection problems, the UHF IF band is utilized, in addition to the convenience of multiple conversion receivers, since SAW filters with multiple poles and zeroes required for the overall IF response that desires to have flat passband and sloped skirt rejection are more easily achieved in the UHF IF band than in the VHF IF band. Because broadband amplification may be achieved at much lower conductance while suppressing stray capacitance effects, broadband application and generation of gain up to 60-90 dB by controlling the gain is

more easily achieved in the VHF IF band than in the UHF IF band. In an advantageous embodiment of the invention, the UHF IF amplifier that amplifies NTSC signals and employs forward AGC to achieve low noise values and controlled amplification based on the UHF IF amplifier that amplifies DTV signals and employs reverse AGC to achieve linearity of gain may be used not only in the VHF IF band but also in UHF IF band.

For the radio receiver part disclosed in detail in Figure 1 through Figure 8, as a result of TV signals transmitted to the UHF IF band that exhibit a reverse frequency spectrum in TV broadcasting, the first detector (2) may generate the UHF IF band based on the difference after the frequency spectrum of TV signals selected to receive from frequencies of the first local oscillators has been subtracted. The first local oscillator that may be controlled much more than the 2:1 region in frequencies is not conveniently tuned rather than generating the UHF IF band based on the sum of frequency spectrum of TV signals that have been selected to receive the frequencies of the first local oscillator applied. Therefore, the utilization of the second local oscillations below the UHF IF band results in TV signals transmitted to the VHF IF band that exhibits a frequency spectrum inverted relative to the transmitted spectrum, while the utilization of the second oscillations exceeding the UHF IF band results in TV signals transmitted to the VHF IF band that exhibits a frequency spectrum not inverted relative to the transmitted spectrum. Before the baseband synchrodyne circuit (12) is completely synchrodyned to a baseband in the digital system, it is desirable to maintain VHF IF signals for the spectrum reserved for promoting digital processing provided that the first amplification IF signal form the VHF IF amplifier (11) takes the form of being down-converted to much lower IF band for digitization. Utilization of the third local oscillations below the VHF IF band results in TV signals transmitted to the VHF IF band that exhibits the frequency spectrum inverted relative to the transmitted spectrum, while the utilization of the third oscillations above the VHF IF band results in TV signals transmitted to a much lower IF band that exhibits a frequency spectrum not inverted relative to spectrum of TV signals transmitted to the VHF IF band.

For the radio receiver part disclosed in detail in Figure 1 through Figure 8, the first local oscillator included in the first detector (2) may be one that tunes from about 965 MHz to about 1815 MHz. Thus, the first detector (2) generates UHF IF signals in the band that has been expanded by 917 MHz to 923 MHz. The second local oscillator may be the one that supplies oscillation at 876 MHz to the second mixers (6,9) or the second mixers (6,37,38). The UHF IF band and frequency of the second oscillations commonly generated at a single conversion analog TV receiver is used for conventional techniques so that NTSC signals transmitted as the VHF intermediate frequency within the 41-47 MHz VHF IF band may be located that has a video carrier transmitted as 45.75 MHz and an audio carrier transmitted as 41.25 MHz.

In a single conversion analog TV receiver, the VHF IF band is established at frequencies that are sufficiently below the minimum VHF TV broadcasting channel and not high, if possible, so that the second harmonic of the NTSC FM audio carrier may not be drawn into the FM broadcasting band of 88-108 MHz. The VHF IF band is maintained high, if possible, so that the image frequency from single conversion may be drawn close to the desirable signals that will be selected by amplification of a tuned radio frequency. For this reason the third harmonic of the NTSC FM audio carrier is not established above the high frequency (HF) band that is drawn into the FM broadcasting band of 88-108 MHz. Rather, if it is much better maintained above 30 MHz, the VHF IF band may be selected to be much lower in terms of frequencies.

If the baseband synchrodyne circuit (12) takes the form of an inverted spectrum, the first VHF IF signal from the VHF IF amplifier (11) is subjected to down-converting to a much lower IF band. If it is desirable for the down-converted DTV signal to have a frequency spectrum that has not been inverted from the frequency spectrum of the DTV signal, the third local oscillations used for down-conversion must be at frequencies high in the VHF IF band. Establishing the third local oscillations above 47 MHz is likely to increase the danger of interfering with adjacent FM broadcasting receivers. Therefore, frequencies of the second local oscillations are raised to be closer to the UHF IF band and to lower the frequency area of the VHF IF significantly so that the third local oscillations may be below 44 MHz. This allows frequencies of the second local oscillations to increase so that they may exceed the upper limit frequency of 890 MHz of the channel 83. In addition, the UHF IF band may be controlled within acceptable areas. If frequencies of the second local oscillations selected from 890.5 MHz and the UHF IF band are established at 925.5-931.5 MHz, the third local oscillations may be maintained below 44 MHz. If the carrier of DTV signals transmitted to the final IF band that is much lower than the VHF IF band exists near the lower limit frequency of the IF band, the frequency spectrum within the VHF IF band is inverted from the spectrum of DTV signals transmitted to a DTV receiver because it is better to use the second local oscillations of lower UHF IF band frequencies.

If the carrier of DTV signals transmitted to the final IF band that is much lower than the VHF IF band exists near the upper limit frequency of the final IF band in a triple conversion DTV receiver, the third local oscillations must approach closer the intermediate band frequency of the VHF IF band than the VSB carrier transmitted to the VHF IF band in terms of frequencies. If the VSB carrier exceeds the lower limit frequency of the VHF IF band due to the first local oscillations exceeding the UHF IF band, the third local oscillations must exceed the VHF IF band for the carrier of the VSB DTV signal so that the intermediate band frequency within the final IF band may be exceeded. It is desirable that the third local oscillations be lower than the frequency of 44 MHz so that the second harmonic may not be drawn into the FM broadcasting

band. In addition, the NTSC sound carrier is located at the peak of the VHF IF band, which is desirable for that the second harmonic may not be drawn into the FM broadcasting band. If the second local oscillations exceeding the UHF IF band do not result in spectrum inversion and if the third local oscillations must exceed the VHF IF band to establish the carrier of the VSB DTV signal exceeding the intermediate band frequency within the IF band, the VHF IF band must be located much below the frequency of 41-47 MHz. If the VHF IF band is located much below 36-42 MHz, the third harmonics of signals within this band cover the peak portion of the FM broadcasting band. Under such restrictions, the VSB carrier within the final IF band cannot be below 7.69 MHz.

If the VSB carrier for the carrier of VSB DTV signals that exceed the intermediate band frequency within the third IF band is below the upper limit frequency of the VHF IF band due to third local oscillations falling below the UHF IF band, the third local oscillations must be below the VHF IF band. If the VSB carrier is below the 47 MHz within the VHF IF band of 41-47 MHz, the third local oscillations at the lower VHF IF band except 36 MHz or higher exceed the range of the FM broadcasting band to have harmonics. Under such restrictions the VSB carrier within the third IF band may be about 10.69 MHz. If an UHF IF is established slightly higher in terms of frequency, the VSB carrier of 10.76 MHz is accepted. The VHF IF band of 41-47 MHz is possible with the second local oscillation that is drawn into the UHF TV broadcasting band. If frequencies of the second local oscillations are selected at 890.5 MHz, the UHF IF band must be within 931.5-937.5 MHz.

As shown in Figure 1 through Figure 8, Figure 9 illustrates the remaining part of the television set that employs a radio receiver. As data restored by the symbol decoder (14) in a serial bit form are supplied to a data interleaver (50), it supplies interleaved data in the parallel bit form to a trellis decoder circuit (51). The trellis decoder circuit (51) supplies its output signal in the parallel bit form to a data de-interleaver (52), while the output signal from the data de-interleaver (52) is analyzed by a passing circuit (53) to bytes to apply to a decoder circuit (54) that decodes Reed-Solomon forward error correcting coding. The output signal from the Reed-Solomon decoder circuit (54) is supplied to a data derandomizer (55) that supplies data packets to a packet sorter (56). The packet sorter (56) selects a video data packet from an MPEG-2 decoder (57), which supplies digital luminance (y) signal and digital chromaticity (U and V) signal to a video source selector circuit (58) within the response delayed for the video data packet. Furthermore, the packet order (56) selects an audio data packet from a digital audio decoder (59), which generates audio signals of digital stereophonic sound that are supplied to DACs (digital-to-audio converters, 60 and 61). DACs (60, 61) convert the audio signals of analog stereophonic sound supplied to an audio source selector circuit (62) to audio signals. The

output signal from an equalizer (13) is supplied to an ATSC synchronizing separation circuit (63) for detecting code groups that establish data fields and data segments in a data stream.

The signal that the ATSC synchronizing separation circuit (63) calculates at the start point of a data field is supplied to a controller (64) via connection (65), while the signal that the ATSC synchronizing separation circuit (63) calculates at the start point of data segment is supplied to a controller (64) via connection (66). The controller (64) supplies the signal applied via connection (67) to the video source selector circuit (58) that controls selection of a video source, while the signal applied via connection (68) is supplied to the audio source selector circuit (62) that controls selection of an audio source. When DTV signals are received, the controller (64) controls the video source selector circuit (58) to select digital luminance (y) signal and digital chromaticity (U and V) signal that has supplied by the MPEG-2 decoder (57) to apply to a video scan buffer (69). Lighting from the video scan buffer (69) is controlled by the controller (64) via a control link (70), while leading to the video scan buffer (69) is controlled by the controller (64) via a control link (71). When DTV signals are received, the controller (64) controls the audio source selector circuit (62) to select the audio signal of analog stereophonic sound that has been supplied by DACs (60, 61) for amplification by audio amplifiers (72, 74), and the audio amplifiers (72, 74) respectively supply their amplifier output to a left speaker (73) and a right speaker (75). The controller (64) recognizes that DTV signals are being received when the ATSC synchronizing separation circuit (63) detects the starting point of a data field within a DTV signal. In addition, the circuit that detects the existence of DTV signals being received maintained by the pilot carrier may be used to notify the controller (64) of DTV signal reception.

The video scan buffer (69) is read to supply raster-scanned digital luminance (y) signals to a digital/analog converter (76) and supply digital chromaticity (U and V) signals to digital/analog converters (77,78). The resulting analog luminance (y) signal from the digital/analog converter (76) and the analog chromaticity (U and V) signal from the digital/analog converters (77, 78) are supplied to a color matrixing circuit (79) in analog form to generate red, green and blue analog color signals that are respectively amplified by amplifiers (80,81,82). The amplified red, green and blue color signals are supplied to the display apparatus (83) that is controlled by the controller (64). In an alternative to the TV illustrated in Figure 9, the raster-scanned digital luminance (y) signals and the digital chromaticity (U and V) signals that have been read from the video scan buffer (69) may be supplied to the color matrixing circuit (79) in digital form to generate red, green, and blue digital color signals that are converted to red, green, and blue analog color signals to be respectively amplified by the amplifiers (80,81,82).

In the analog TV part of a receiver the video detector (20) supplies composite video signals to an NTSC synchronizing separator circuit (84). The NTSC synchronizing separator circuit (84) supplies horizontal and vertical synchronizing signals to the controller (64) via corresponding connections (85, 86), respectively. In addition, the video detector (20) also supplies composite video signals to a luminance/chromaticity separator circuit (87), while the luminance/chromaticity separator circuit (87) separates an analog chrominance subcarrier signal to apply to a color circuit (88) and separates an analog baseband luminance signal to apply to an analog/digital converter (89). The color circuit (88) receives the burst gate signal from the NTSC synchronizing separator circuit (84) via connection (90), and responds to an input signal to supply an analog color-difference (U) signal to an analog/digital converter (91) and to supply another analog color-difference (V) signal to an analog/digital converter (92). As a digitized luminance signal is supplied to a scanning line doubler (93) by the analog/digital converter (89), 525 scanning lines of NTSC luminance are converted to a luminance signal with 1050 scanning lines. The scanning doubler (93), analog/digital converter (91) and analog/digital converter (92) supply Y, U and V signals that have been digitized for selection at the video scan buffer (69) to the video source selector circuit (58) if it is determined by the controller (64) that NTSC signals are being received and DTV signals are not being received. The FM detector (27) supplies composite video signals to a stereophonic sound decoder (94), which responds to the composite video signals to supply the signal of stereophonic sound to the audio source selector circuit (62). The controller (64) receives the NTSC/ATSC control signal form the threshold detector (29) and uses it to determine whether NTSC signals are being received. When it is determined by the controller that NTSC signals are being received and DTV signals are not being received, the controller (64) controls the audio source selector circuit (62) to supply stereophonic sound signals of the audio amplifiers (72,74) that respond to those of the decoder of stereophonic sound (94).

Figure 9 shows a TV set with integrated video recorder (95), which is known in the industry as a combination. Figure 9 illustrates the audio signal of analog stereophonic sound from the audio source selector circuit (62), which is to be digitized by a digital video recorder (95) rather than by an analog video recorder, and analog baseband luminance and baseband chromaticity signals from digital/analog converters (76,77,78) that are supplied to a video recorder (95). The video recorder (95) apparatus allows recording of TV signals and NTSC signals, which is not possible by the digital videotape recorder that is furnished to record digital television information packet before being decoded by the MPEG-2 video decoder (57) and digital audio decoder (59). There are, of course, embodiments of the invention in which elements 72-75 and 79-83 are not present.

Effect of the Invention

The DTV receiver that receives both VSB DTB used for groundwave public broadcasting and QAM DTV used for wire broadcasting is disclosed by C. B. Patel and the present inventor in their US Patent No. 5,506,636, filed on April 9, 1996, and entitled, "HDTV Signal Receiver with Imaginary-Sample-Presence-Detector for QAM/VSB Mode Selection." If the SAW filter (4) takes the form of having essentially linear phase and horizontal amplitude response with bandwidth of -1 dB to -1 dB at 6 MHz, the response of the IF amplifier (11) may be used not only to supply input signals to the circuit (12) that performs synchrodyning on VSB DTV signals to a baseband but also to supply input signals to the circuit that performs synchrodyning on QAM DTV signals to a baseband. If the SAW filter (4) takes the form of a much narrower bandwidth, QAM DTV signals probably require a parallel IF amplifier circuit and an SAW filter of the form that has essentially linear phase and horizontal amplitude response with a bandwidth of -1 dB to -1 dB at 6 MHz for which the first detector (2) response is selected from separating an IF amplifier circuit as an input signal. In separating an IF amplifier a mixer may be included that performs heterodyning on amplified UHF IF signals with oscillations of the second local oscillator (5) to generate VHF IF signals.

Claims

1. A radio receiver, which selects one signal from multiple television signals including several digital television signals, comprising,

a first detector that generates a first detector response to one signal selected from said television signals;

a first intermediate frequency amplifier circuit that supplies an amplifier first VHF intermediate frequency signal and an amplified second VHF intermediate frequency signal by respectively receiving said first detector response as an input signal;

a synchrodyning circuit that generates a baseband signal by responding to said amplified first VHF intermediate frequency signal;

an equalization filter circuit that generates an equalized baseband signal by responding to said baseband signal;

a symbol decoder that supplies data within a serial bit form by responding to said equalized baseband signal when one signal selected from said television signals is a digital television signal; and

a video detector that supplies a composite video signal by responding to the amplified second VHF intermediate frequency when one signal selected from said television signals is an analog television signal.

2. The radio receiver of Claim 1, which takes the form wherein said first detector generates said first detector response within the UHF intermediate frequencies that are higher than the UHF established as a television broadcasting channel.

3. The radio receiver of Claim 2 wherein,

said first intermediate frequency circuit comprises

a first UHF intermediate frequency amplifier that amplifies said first detector response to generate the amplified first UHF intermediate frequency signal,

a first down-converter that down-converts said first UHF intermediate frequency signal amplified to generate the first VHF down-converter response, and

serial connection of the first VHF intermediate frequency amplifier that amplifies said first down-converter response to generate said amplified first VHF intermediate frequency signal,

and said second intermediate frequency circuit comprises

the second UHF intermediate frequency amplifier that amplifies said first detector response to generate the amplified second UHF intermediate frequency signal,

the second down-converter that down-converts said amplified second UHF intermediate frequency signal to generate the second VHF down-converter response, and

serial connection of the second VHF intermediate frequency amplifier that amplifies the second down-converter response to generate said second VHF intermediate frequency amplifier response.

4. The radio receiver of Claim 3,

wherein said first down-converter and second down-converter simultaneously include the second local oscillator that generates the second UHF local oscillations, said first down-converter includes the respective second mixer that mixes said second local oscillations with said amplified UHF intermediate frequency to generate said first VHF down-converter response, and said second down-converter includes the respective second mixer that mixes said second local oscillations with said amplified UHF intermediate frequency to generate said second VHF down-converter response.

5. The radio receiver of Claim 4,

wherein said second local oscillator generates the second local oscillations at frequencies below said UHF intermediate frequency band.

6. The radio receiver of Claim 4,

wherein said second local oscillator generates the second local oscillations at frequencies above said UHF intermediate frequency band.

7. The radio receiver of Claim 3,

further comprising an automatic gain control circuit, wherein, as said second VHF intermediate frequency amplifier includes amplifier stages that provide controlled gains by responding to automatic gain control signals, these amplifier stages at least initially use forward automatic gain control to maintain low noise values, and

said automatic gain control signals are generated by responding to said composite video signals supplied from said video detector.

8. The radio receiver of Claim 3,

further comprising a first automatic gain control circuit, wherein, as said first VHF intermediate frequency amplifier includes respective amplifier stages that provide controlled gains by responding to the first automatic gain control signals, each of these amplifier stages uses reverse automatic gain control to obtain linear gain, and

said first automatic gain control signals are generated by responding to said baseband signal part generated by said synchrodyning circuit.

9. The radio receiver of Claim 8,

further comprising a second automatic gain control circuit, wherein, as said second VHF intermediate frequency amplifier includes respective amplifier stages that provide controlled gains by responding to the second automatic gain control signals, these amplifier stages at least initially use forward automatic gain control to maintain low noise values, and

said second automatic gain control signals are generated by responding to said composite video signal parts supplied from said video detector.

10. The radio receiver recited Claim 9,

further comprising the first SAW filter (surface acoustic wave filter) that is included within said first intermediate frequency amplifier circuit that limits the entire bandwidth of said first intermediate frequency amplifier circuit so that entire digital television signals may essentially pass by filtering said first amplification intermediate frequency signal preceding provision to said first down-converter that performs down-converting, has a horizontal passband with a steep-sloped rejection skirt, and provides frequencies within said passband with linear group delay.

11. The radio receiver of Claim 10,

further comprising a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplification UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide responses corresponding to NTSC video signals within a video detector area.

12. The radio receiver of Claim 10,

further comprising a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplification UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide bandpass response to NTSC video signals, and passes in-channel NTSC sound signals.

13. The radio receiver of Claim 10 further comprising.

a bandpass filter that provides narrowband response to the video carrier component that exhibits at said first amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal, and

an AFT detector that responds to the narrowband response of said bandpass filter that supplies AFT signals to said first detector when one signal selected from said television signals is an analog television signal.

14. The radio receiver of Claim 13 further comprising,

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplification UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting, to provide responses corresponding to NTSC video signals within a video detector area, and passes an in-channel frequency modulated audio carrier;

a sound trap filter that applies said second VHF intermediate frequency amplifier response to said video detector with frequency selections that suppress a frequency modulated audio carrier:

an audio carrier selection filter that supplies response to the frequency modulated audio carrier within said second VHF intermediate frequency amplifier response when one signal selected from said television signals is an analog television signal:

the third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal:

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier sound signal to generate a baseband sound signal.

15. The radio receiver of Claim 10 further comprising,

a first bandpass filter that provides a narrowband response to the pilot carrier component that is present in said first amplified VHF intermediate frequency signal when one signal selected from said television signals is a digital television signal, and

a first AFT detector that responds to the narrowband response of said first bandpass filter that supplies the first AFT signal to said first detector when one signal selected from said television signals is a digital television signal.

16. The radio receiver of Claim 15 further comprising,

a second bandpass filter that provides a narrowband response to the pilot carrier component that is present in said first amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal, and

a second AFT detector that responds to the narrowband response of said first bandpass filter that supplies the second AFT signal to said first detector when one signal selected from said television signals is an analog television signal.

17. The radio receiver of Claim 16 further comprising,

the second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting, to provide responses corresponding to NTSC video signals within a video detector area, and passes an in-channel frequency modulated audio carrier;

a sound trap filter that applies said second VHF intermediate frequency amplifier output to said video detector with frequency selections that suppress a frequency modulated audio carrier;

an audio carrier selection filter that supplies response to said in-channel frequency modulated audio carrier existing within said second VHF intermediate frequency amplifier response when one signal selected from said television signals is an analog television signal;

a third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said second bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier sound signal to generate a baseband sound signal.

18. The radio receiver of Claim 17 further comprising,

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates an indication that one signal selected from said television signals is an analog television signal; and

an AFT signal selector that responds to the absence of an indication that applies said first AFT signal to said first detector and responds to the presence of indication that applies said second AFT signal to said first detector.

19. The radio receiver of Claim 16 further comprising.

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide bandpass response to NTSC video signals, and passes an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said video detector, traps said in-channel frequency modulated audio carrier, and provides response corresponding to the NTSC video signal within a video carrier area;

an audio carrier selection filter that supplies response to the frequency modulated audio carrier within said second VHF intermediate frequency amplifier when one signal selected from said television signals is an analog television signal;

the third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said second bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier signal to generate a baseband sound signal.

20. The radio receiver of Claim 19 further comprising,

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates indication that one signal selected from said television signals is an analog television signal; and

an AFT signal selector that responds to the absence of indication that applies said first AFT signal to said first detector and responds to presence of indication that applies said second AFT signal to said first detector.

21. The radio receiver of Claim 14 further comprising,

a second bandpass filter that provides a narrowband response to the video carrier component that is present in said first amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal, and

a second AFT detector that responds to the narrowband response of said first bandpass filter that supplies the second AFT signal to said first detector when one signal selected from said television signals is an analog television signal.

22. The radio receiver of Claim 21 further comprising.

the second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplification UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide bandpass response to NTSC video signals, and passes an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified VHF intermediate frequency signal preceding provision to said video detector, traps said in-channel frequency modulated audio carrier, and provides response corresponding to the NTSC video signal within a video carrier area;

an audio carrier selection filter that supplies response to the frequency modulated audio carrier within said second VHF intermediate frequency amplifier when one signal selected from said television signals is an analog television signal;

a third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said second bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier signal to generate a baseband sound signal.

23. The radio receiver of Claim 22 further comprising,

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates indication that one signal selected from said television signals is an analog television signal; and

an AFT signal selector that responds to the absence of an indication that applies said first AFT signal to said first detector and responds to the presence of an indication that applies said second AFT signal to said first detector.

24. The radio receiver of Claim 3 further comprising,

a third intermediate frequency amplifier circuit that accepts said first detector response as an input signal and supplies the third amplified VHF intermediate frequency signal; and

a sound signal regeneration circuit that regenerates a baseband sound signal from said third amplified VHF intermediate frequency signal.

25. The radio receiver of Claim 24,

wherein the second intermediate frequency amplifier circuit and said third intermediate frequency amplifier circuit commonly include said second UHF intermediate frequency amplifier that amplifies said first detector response to generate the second amplified UHF intermediate frequency signal, and

said third intermediate frequency amplifier circuit further comprises

a third down-converter that down-converts said second UHF intermediate frequency signal to generate a third VHF down-converter response and a third VHF intermediate frequency amplifier connected in series behind said second UHF intermediate frequency amplifier that amplifies said third down-converter response to generate a third amplified VHF intermediate frequency signal.

26. The radio receiver of Claim 25 wherein,

said first down-converter, the second down-converter and the third down-converter commonly include the second local oscillator that generates the second UHF local oscillations,

said first down-converter includes the second mixers that respectively mix said second oscillations with said first amplified UHF intermediate frequency signal to generate said first VHF down-converter response,

said second down-converter includes the second mixers that respectively mix said second oscillations with said second amplified UHF intermediate frequency signal to generate said second VHF down-converter response, and

said third down-converter includes the second mixers that respectively mix said second oscillations with said third amplified UHF intermediate frequency signal to generate said second VHF down-converter response.

[27.] The radio receiver of Claim 25 further compromising,

each of the amplifier stages wherein said first VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the first automatic gain control signal to provide controlled gain, wherein these amplifier stages use reverse automatic gain control to exhibit linear gain, said second VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the second automatic gain control signal to provide controlled gain, said amplifier stages at least initially use forward automatic gain control to maintain low noise values, and the third VHF intermediate frequency amplifier is similar to said second VHF intermediate frequency amplifier in its configuration and responds to said automatic gain control circuit to provide controlled gain,

a first automatic gain control circuitry that generates said first automatic gain control signal by responding to said baseband signal part that has been generated by said synchronizing circuit; and

a second automatic gain control circuit that generates said second automatic gain control signal by responding to said composite video signal part that has been supplied from said video detector.

28. The radio receiver recited Claim 27 further comprising,

a first SAW filter that is included within said first intermediate frequency amplifier circuit that limits the entire bandwidth of said first intermediate frequency amplifier circuit so that entire digital television signals may essentially pass by filtering said first amplified UHF intermediate frequency signal preceding provision to said first down-converter that performs down-converting, has a horizontal passband with a steep-sloped rejection skirt, and provides frequencies within said passband with linear group delay;

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide bandpass response to NTSC video signals, and passes an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said video detector, traps said in-channel frequency modulated audio carrier, and provides a response corresponding to the NTSC video signal within a video carrier area;

an audio carrier selection filter that supplies response to the frequency modulated audio carrier within said third VHF intermediate frequency amplifier when one signal selected from said television signals is an analog television signal;

a bandpass filter that provides narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signals is an analog television signal;

the third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier signal to generate a baseband sound signal.

29. The radio receiver of Claim 28 further comprising,

an AFT detector that responds to the narrowband response of said bandpass filter that supplies AFT signals to said first detector when one signal selected from said television signals is an analog television signal.

30. The radio receiver of Claim 28,

wherein said bandpass filter is accessed to provide narrowband response to the video carrier component that is present in said first amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal.

31. The radio receiver of Claim 28,

wherein said bandpass filter is accessed to provide narrowband response to the video carrier component that is present in said second amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal.

32. The radio receiver recited Claim 27 further comprising,

a first SAW filter that is included within said first intermediate frequency amplifier circuit that limits the entire bandwidth of said first intermediate frequency amplifier circuit so that entire digital television signals may essentially pass by filtering said first amplified UHF intermediate frequency signal preceding provision to said first down-converter that performs down-converting, has a horizontal passband with a steep-sloped rejection skirt, and provides frequencies within said passband with linear group delay;

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide bandpass response to NTSC video signals, and passes an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said video detector, traps said in-channel frequency modulated audio carrier, and provides response corresponding to the NTSC video signal within a video carrier area;

an audio carrier selection filter that supplies response to the frequency modulated audio carrier within said third VHF intermediate frequency amplifier when one signal selected from said television signals is an analog television signal;

a first bandpass filter that provides narrowband response to the pilot carrier component that is present in said first VHF intermediate frequency signal when one signal selected from said television signals is a digital television signal;

a first AFT detector that responds to the narrowband response of said first bandpass filter that supplies the first AFT signal to said first detector when one signal selected from said television signals is a digital television signal;

a second bandpass filter that provides narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signals is an analog television signal;

a second AFT detector that responds to the narrowband response of said first bandpass filter that supplies the second AFT signal to said first detector when one signal selected from said television signals is an analog television signal;

a third mixer that mixes by multiples the response of said audio carrier selection filter with the response of said bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier signal to generate a baseband sound signal.

33. The radio receiver of Claim 32,

wherein said second bandpass filter is accessed to provide narrowband response to the video carrier component that is present in said first amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal.

34. The radio receiver of Claim 32,

wherein said second bandpass filter is accessed to provide narrowband response to the video carrier component that is present in said second amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal.

35. The radio receiver of Claim 24,

wherein said third intermediate frequency amplifier circuit further comprises

said third UHF intermediate frequency amplifier that amplifies said first detector response to generate the third amplified UHF intermediate frequency signal;

a third down-converter that down-converts said third amplified UHF intermediate frequency signal to generate the third VHF down-converter response; and

a third VHF intermediate frequency amplifier that amplifies said third down-converter response to generate the third amplified VHF intermediate frequency signal.

36. The radio receiver of Claim 35,

said first down-converter, second down-converter and third down-converter commonly include a second local oscillator that generates second UHF local oscillations,

said first down-converter includes second mixers that respectively mix said second oscillations with said first amplified UHF intermediate frequency signal to generate said first VHF down-converter response,

said second down-converter includes second mixers that respectively mix said second oscillations with said second amplified UHF intermediate frequency signal to generate said second VHF down-converter response, and

said third down-converter includes second mixers that respectively mix said second oscillations with said third amplified UHF intermediate frequency signal to generate said second VHF down-converter response.

37. The radio receiver of Claim 35, further comprising,

each of the amplifier stages wherein said first VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the first automatic gain control signal to provide controlled gain, these amplifier stages use reverse automatic gain control to exhibit linear gain, said second VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the second automatic gain control signal to provide controlled gain, these amplifier stages at least initially use forward automatic gain control to maintain low noise values, and the third VHF intermediate frequency amplifier is similar to said second VHF intermediate frequency amplifier in its configuration and responds to said automatic gain control circuit to provide controlled gain,

the first automatic gain control circuit that generates said first automatic gain control signal by responding to said baseband signal part that has been generated by said synchronizing circuit; and

the second automatic gain control circuitry that generates said second automatic gain control signal by responding to said composite video signal part that has been supplied from said video detector.

38. The radio receiver recited Claim 37, further comprising,

a first SAW filter that is included within said first intermediate frequency amplifier circuit that limits the entire bandwidth of said first intermediate frequency amplifier circuit so that entire digital television signals may essentially pass by filtering said first amplified UHF intermediate frequency signal preceding provision to said first down-converter that performs down-converting, has a horizontal passband with a steep-sloped rejection skirt, and provides frequencies within said passband with linear group delay;

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide response corresponding

to an NTSC video signals within video carrier area, and blocks an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said third intermediate frequency amplifier circuit that limits the entire bandwidth of said third intermediate frequency amplifier circuit by filtering said third amplified UHF intermediate frequency signal preceding provision to said third down-converter that performs down-converting to provide double-humped frequency selection response to the NTSC signal that has the respective maximum responses near video carrier and audio carrier frequencies;

an intercarrier sound detector that responds to said third amplified VHF intermediate frequency signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to the intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier sound signal to regenerate a baseband sound signal.

39. The radio receiver of Claim 38, further comprising,

a first bandpass filter that provides narrowband response to the pilot carrier component that is present in said first VHF intermediate frequency signal when one signal selected from said television signals is a digital television signal;

a first AFT detector that responds to the narrowband response of said first bandpass filter that supplies the first AFT signal when one signal selected from said television signals is a digital television signal;

a second bandpass filter that provides narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signal is an analog television signal;

a second AFT detector that responds to the narrowband response of said first bandpass filter that supplies the second AFT signal when one signal selected from said television signal is an analog television signal;

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates the indication that one signal selected from said television signals is an analog television signal; and

an AFT signal selector that responds to absence of indication that applies said first AFT signal to said first detector and responds to presence of said indication that applies said second AFT signal to said first detector.

40. The radio receiver of Claim 24,

wherein the first intermediate frequency amplifier circuit and said third intermediate frequency amplifier circuit commonly include said first UHF intermediate frequency amplifier that amplifies said first detector response to generate the first amplified UHF intermediate frequency signal, and

said third intermediate frequency amplifier circuit further comprises

the third down-converter that down-converts said first UHF intermediate frequency signal to generate the third VHF down-converter response and the third VHF intermediate frequency amplifier connected in series behind said first UHF intermediate frequency amplifier that amplifies said third down-converter response to generate the third amplified VHF intermediate frequency signal.

41. The radio receiver of Claim 40, wherein,

said first down-converter, second down-converter and third down-converter commonly include the second local oscillator that generates second UHF local oscillations,

said first down-converter includes the second mixers that respectively mix said second oscillations with said first amplified UHF intermediate frequency signal to generate said first VHF down-converter response,

said second down-converter includes second mixers that respectively mix said second oscillations with said second amplified UHF intermediate frequency signal to generate said second VHF down-converter response, and

said third down-converter includes the second mixers that respectively mix said second oscillations with said third amplified UHF intermediate frequency signal to generate said second VHF down-converter response.

42. The radio receiver of Claim 40, further comprising,

each of the amplifier stages wherein said first VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the first automatic gain control signal to provide controlled gain, these amplifier stages use reverse automatic gain control to exhibit linear gain, said second VHF intermediate frequency amplifier includes each of the amplifier stages that responds to the second automatic gain control signal to provide controlled gain, these amplifier stages at least initially use forward automatic gain control to maintain low noise values, and the third VHF intermediate frequency amplifier is similar to said second VHF intermediate frequency amplifier in its configuration and responds to said automatic gain control circuit to provide controlled gain,

a first automatic gain control circuitry that generates said first automatic gain control signal by responding to said baseband signal part that has been generated by said synchronizing circuit; and

a second automatic gain control circuitry that generates said second automatic gain control signal by responding to said composite video signal part that has been supplied from said video detector.

43. The radio receiver recited Claim 42, further comprising,

a first SAW filter that is included within said first intermediate frequency amplifier circuit that limits the entire bandwidth of said first intermediate frequency amplifier circuit so that the entire digital television signals may essentially pass by filtering said first amplified UHF intermediate frequency signal preceding provision to said first down-converter that performs down-converting, has a horizontal passband with a steep-sloped rejection skirt, and provides frequencies within said passband with linear group delay;

a second SAW filter that is included within said second intermediate frequency amplifier circuit that limits the entire bandwidth of said second intermediate frequency amplifier circuit by filtering said second amplified UHF intermediate frequency signal preceding provision to said second down-converter that performs down-converting to provide a response corresponding an to NTSC video signals within video carrier area, and blocks an in-channel frequency modulated audio carrier;

a third SAW filter that is included within said third intermediate frequency amplifier circuit that limits the entire bandwidth of said third intermediate frequency amplifier circuit by filtering said third amplified VHF intermediate frequency signal to provide double-humped frequency selection response to the NTSC signal that has the respective maximum responses near video carrier and audio carrier frequencies;

an intercarrier sound detector that responds to said third amplified VHF intermediate frequency signal by being filtered by said third SAW filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal; and

a frequency modulation detector that detects said amplified intercarrier sound signal to regenerate a baseband sound signal.

44. The radio receiver of Claim 43 further comprising,

a first bandpass filter that provides narrowband response to the pilot carrier component that is present in said first VHF intermediate frequency signal when one signal selected from said television signals is a digital television signal;

a first AFT detector that responds to the narrowband response of said first bandpass filter that supplies the first AFT signal when one signal selected from said television signals is a digital television signal;

a second bandpass filter that provides narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signal is an analog television signal;

a second AFT detector that responds to the narrowband response of said first bandpass filter that supplies the second AFT signal when one signal selected from said television signal is an analog television signal;

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates indication that one signal selected from said television signals is an analog television signal; and

an AFT signal selector that responds to the absence of indication that applies said first AFT signal to said first detector and responds to presence of said indication that applies said second AFT signal to said first detector.

45. The radio receiver of Claim 1, further compromising,

each of the amplifier stages wherein said first intermediate frequency amplifier includes each of the amplifier stages that responds to the first automatic gain control signal to provide controlled gain, each of these amplifier stages uses reverse automatic gain control to exhibit linear gain, said second intermediate frequency amplifier includes each of the amplifier stages that responds to the second automatic gain control signal to provide controlled gain, and these amplifier stages at least initially use forward automatic gain control to maintain low noise values;

the first automatic gain control circuitry that generates said first automatic gain control signal by responding to said baseband signal part that has been generated by said synchronizing circuit; and

the second automatic gain control circuitry that generates said second automatic gain control signal by responding to said composite video signal part that has been supplied from said video detector.

46. The radio receiver of Claim 1, further comprising,

each of the amplifier stages wherein said first intermediate frequency amplifier includes each of the amplifier stages that responds to the first automatic gain control signal to provide controlled gain, each of these amplifier stages uses reverse automatic gain control to exhibit linear gain, said second intermediate frequency amplifier includes each of the amplifier stages that responds to the second automatic gain control signal to provide controlled gain, and these amplifier stages at least initially use forward automatic gain control to maintain low noise values;

a radio frequency amplifier that amplifies one signal selected from said television signals to apply to said first detector that is provided for reverse automatic gain control delayed by responding to the third automatic gain control signal;

a first automatic gain control circuit that generates said first automatic gain control signal by responding to said baseband signal part that has been generated by said synchrodyning circuit, and generates said third automatic gain control signal by further responding said baseband signal part that has been generated by said synchrodyning circuit when one signal selected from said television signals is a digital television signal; and

a second automatic gain control circuit that generates said second automatic gain control signal by responding to said composite video signal part that has been supplied from said video detector, and generates said third automatic gain control signal by further responding to said composite video signal part that has been provided from said video detector when one signal selected from said television signals is an analog signal.

47. The radio receiver of Claim 46, further comprising,

a bandpass filter that provides a narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signals is an analog television signal;

an audio carrier selection filter that supplies response to the in-channel frequency modulated audio carrier exhibited within said second VHF intermediate frequency amplifier response when one signal selected from said television signals is an analog television signal;

a mixer that mixes by multiplying the response of said audio carrier selection filter with the response of said bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal;

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates an indication that one signal selected from said television signals is an analog television signal; and

an automatic gain control signal selector that responds to the absence of an indication to select said third automatic gain control signal from said first automatic gain control circuit to said radio frequency amplifier, and responds to the presence of an indication to select said third automatic gain control signal from said second automatic gain control circuitry to said radio frequency amplifier.

48. The radio receiver of Claim 47, further comprising,

a frequency modulation detector to detect said amplified intercarrier sound signal to regenerate a baseband sound signal.

49. The radio receiver of Claim 46, further comprising,

a bandpass filter that provides a narrowband response to the video carrier component that is present in one signal out of said first and second amplified VHF intermediate frequency signals when one signal selected from said television signals is an analog television signal;

a third intermediate frequency amplifier circuit that accepts said first detector response as an input signal, includes each of the amplifier stages that responds to the second automatic gain control signal to supply controlled gain and supplies the third amplified VHF intermediate frequency signal;

a mixer that mixes by multiples said third amplified VHF intermediate frequency signal with the response of said bandpass filter that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal;

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates indication that one signal selected from said television signals is an analog television signal; and

an automatic gain control signal selector that responds to the absence of an indication to select said third automatic gain control signal from said first automatic gain control circuit to said radio frequency amplifier, and responds to the presence of an indication to select said third automatic gain control signal from said second automatic gain control circuit to said radio frequency amplifier.

50. The radio receiver of Claim 49, comprising,

a frequency modulation detector that detects said amplified intercarrier sound signal to regenerate a baseband sound signal.

51. The radio receiver of Claim 49, wherein

each of said second and third intermediate frequency amplifier circuits includes a separated UHF intermediate frequency amplifier.

52. The radio receiver of Claim 49, wherein

said second and third intermediate frequency amplifier circuits include respective UHF intermediate frequency amplifiers.

53. The radio receiver of Claim 46, further comprising

a third intermediate frequency amplifier circuit that accepts said first detector response as an input signal, includes each of the amplifier stages that responds to the second automatic gain control signal to supply controlled gain, and supplies the third amplified VHF intermediate frequency signal;

filtering devices included in said third intermediate frequency amplifier circuit that is made to exhibit double-humped frequency selection response with respective maximum the

responses near video carrier frequency and audio carrier frequency as said third amplified VHF intermediate frequency signal;

an intercarrier sound detector that responds to said third amplified VHF intermediate frequency signal that generates an intercarrier sound signal when one signal selected from said television signals is an analog television signal;

an intercarrier sound intermediate frequency amplifier that responds to said intercarrier sound signal and supplies an amplified intercarrier sound signal;

a circuit that detects when the magnitude of said amplified intercarrier sound signal exceeds the setting that generates indication that one signal selected from said television signals is an analog television signal; and

an automatic gain control signal selector that responds to the absence of an indication to select said third automatic gain control signal from said first automatic gain control circuit to said radio frequency amplifier, and responds to presence of indication to select said third automatic gain control signal from said second automatic gain control circuitry to said radio frequency amplifier.

54. The radio receiver of Claim 53, comprising

a frequency modulation detector that detects said amplified intercarrier sound signal to regenerate a baseband sound signal.

55. The radio receiver of Claim 53, wherein

said first and third intermediate frequency amplifiers circuits include each of the respective UHF intermediate frequency amplifiers.

56. The radio receiver of Claim 53, wherein

each of said first and third intermediate frequency amplifier circuits includes a separated UHF intermediate frequency amplifier.

Diagrams

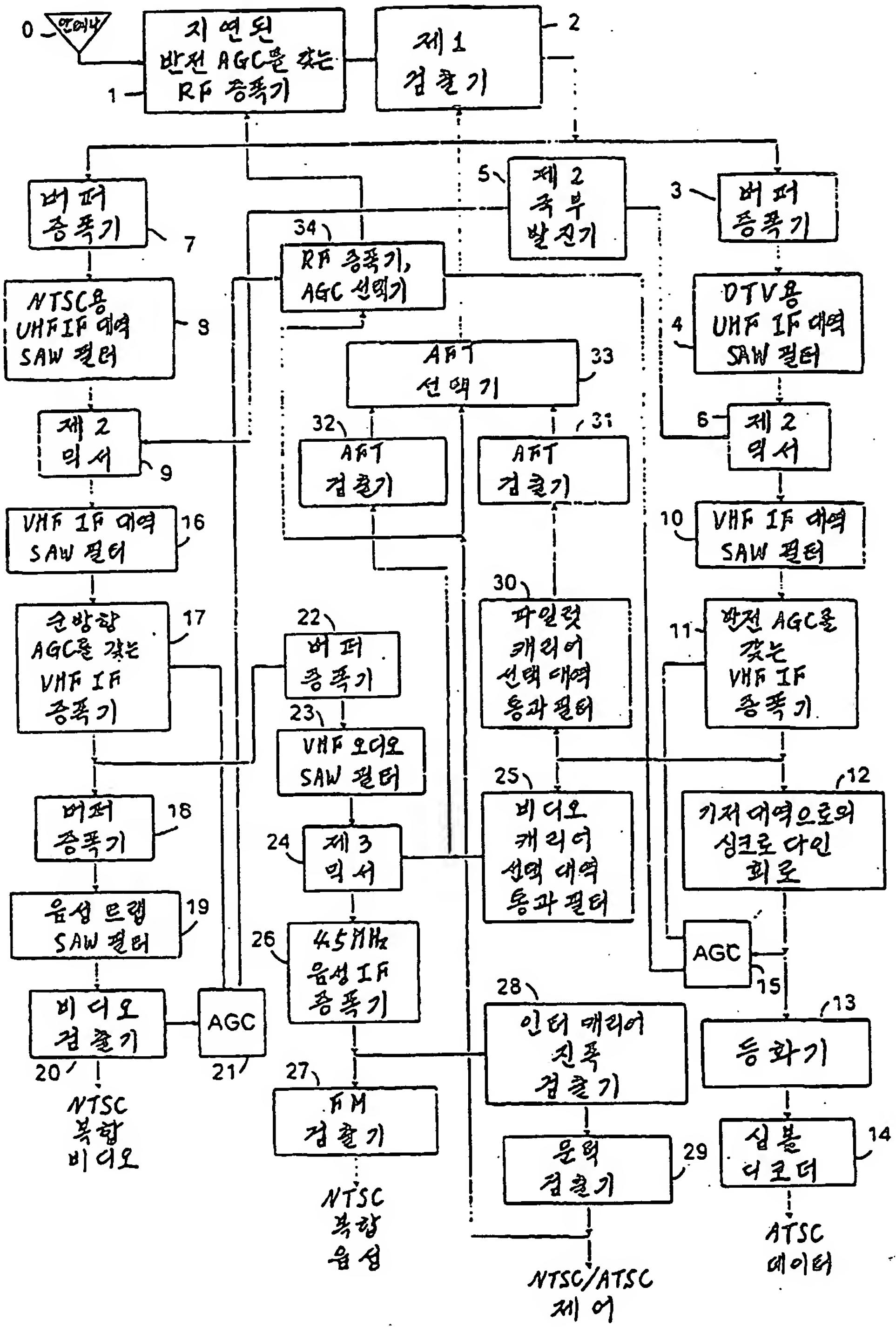


Figure 1

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	7	Buffer amplifier
	8	UHFIF band SAW filter for NTSC
	9	Second mixer
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	12	Synchrodyne circuit to baseband
	13	Equalizer
	14	Symbol decoder
		ATSC data
	16	VHF IF band SAW filter
	17	VHF IF amplifier with forward AGC
	18	Buffer amplifier
	19	Sound trap SAW filter
	20	Video detector
		NTSC composite video
	22	Buffer amplifier
	23	VHF audio SAW filter
	24	Third mixer
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	28	Intercarrier amplitude detector
	29	Threshold detector
		NTSC/ATSC control
	30	Pilot carrier selection bandpass filter
	31	AFT detector
	32	AFT detector
	33	AFT selector
	34	RF amplifier, AGC selector

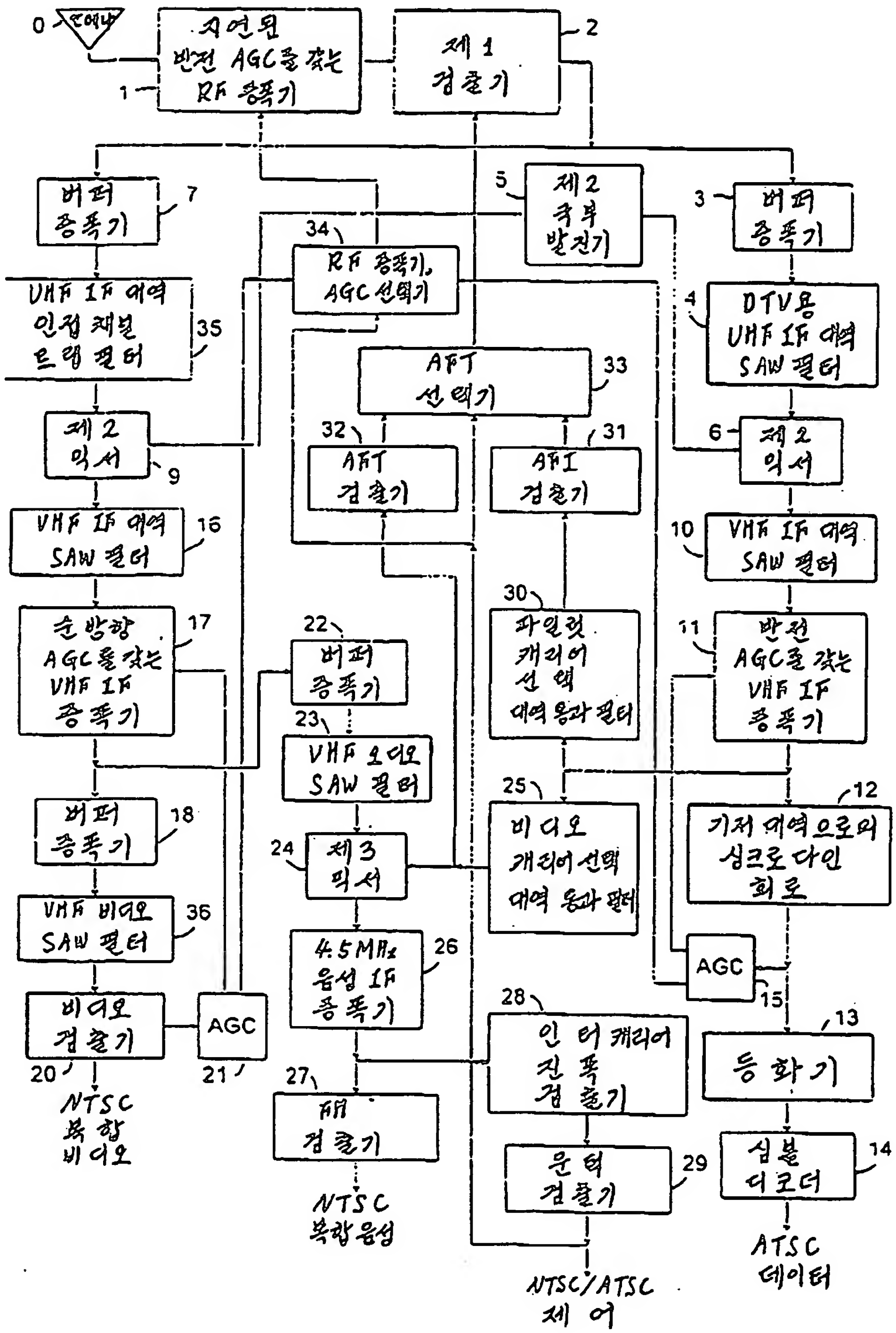
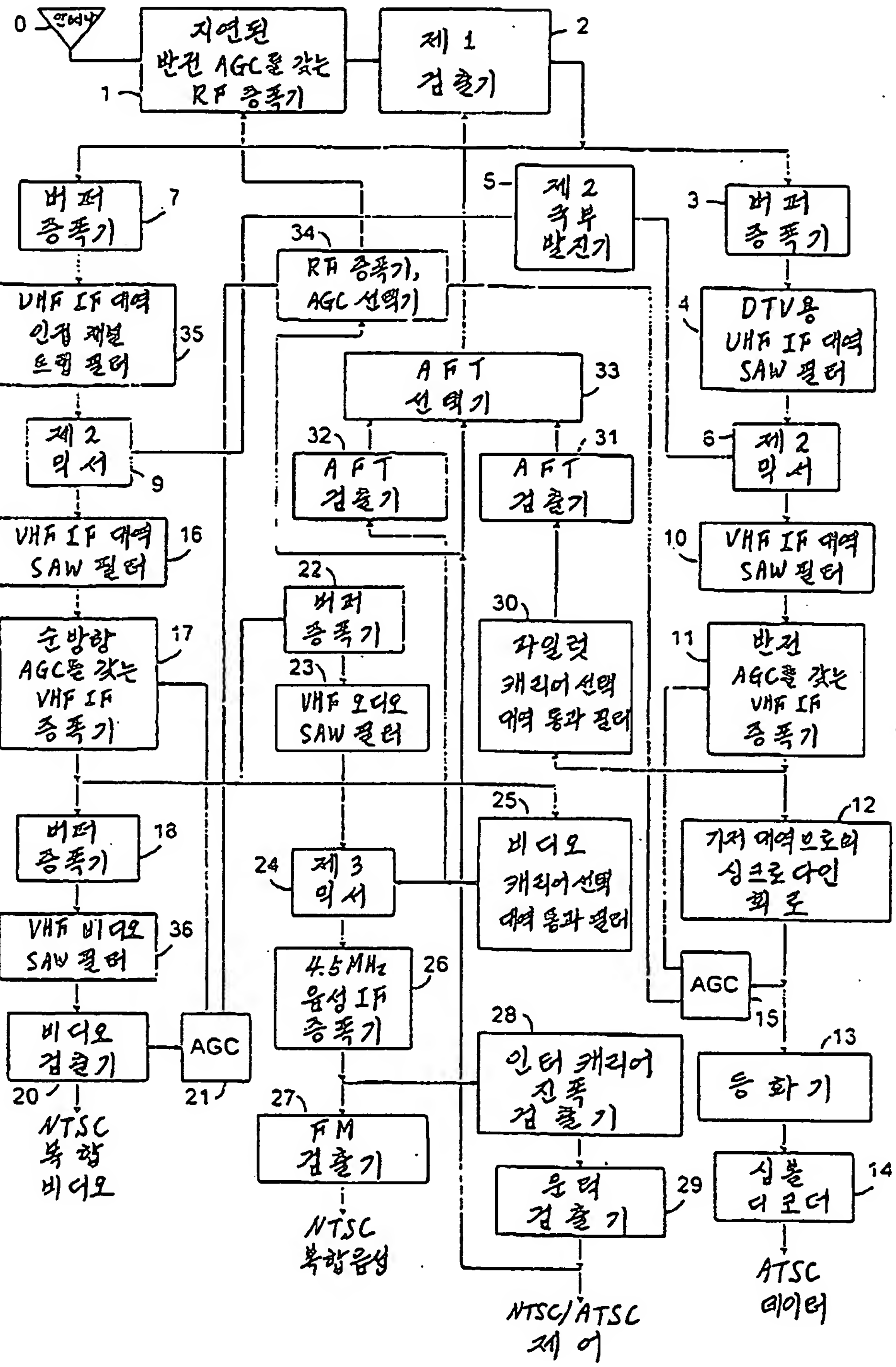

0 안테나
지연된 반전 AGC를 갖는 RF 증폭기
1
제 1 검출기
2
버퍼 증폭기
7
5
제2 국부 발진기
3
버퍼 증폭기
34
RF 증폭기, AGC 선택기
UHF IF 대역 인접 채널 트랩 필터
35
4
DTV용 UHF IF 대역 SAW 필터
AFT 선택기
33
32
AFT 검출기
31
AFT 검출기
제 2 믹서
9
6
제 2 믹서
VHF IF 대역 SAW 필터
16
10
VHF IF 대역 SAW 필터
30
파일럿 캐리어 선택 대역 통과 필터
순방향 AGC를 갖는 VHF IF 증폭기
17
22
버퍼 증폭기
11
반전 AGC를 갖는 VHF IF 증폭기
23
VHF 오디오 SAW 필터
25
비디오 캐리어 선택 대역 통과 필터
12
기저 대역으로의 싱크로다인 회로
버퍼 증폭기
18
24
제3 믹서
VHF 비디오 SAW 필터
36
4.5MHz 음성 IF 증폭기
26
AGC
15
비디오 검출기
AGC
28
인터캐리어 진폭 검출기
13
등화기
20
21
27
FM 검출기
문턱 검출기
29
심볼 디코더
14
NTSC 복합 비디오
NTSC 복합음성
NTSC/ATSC 제어
ATSC 데이터

Figure 2

Key:

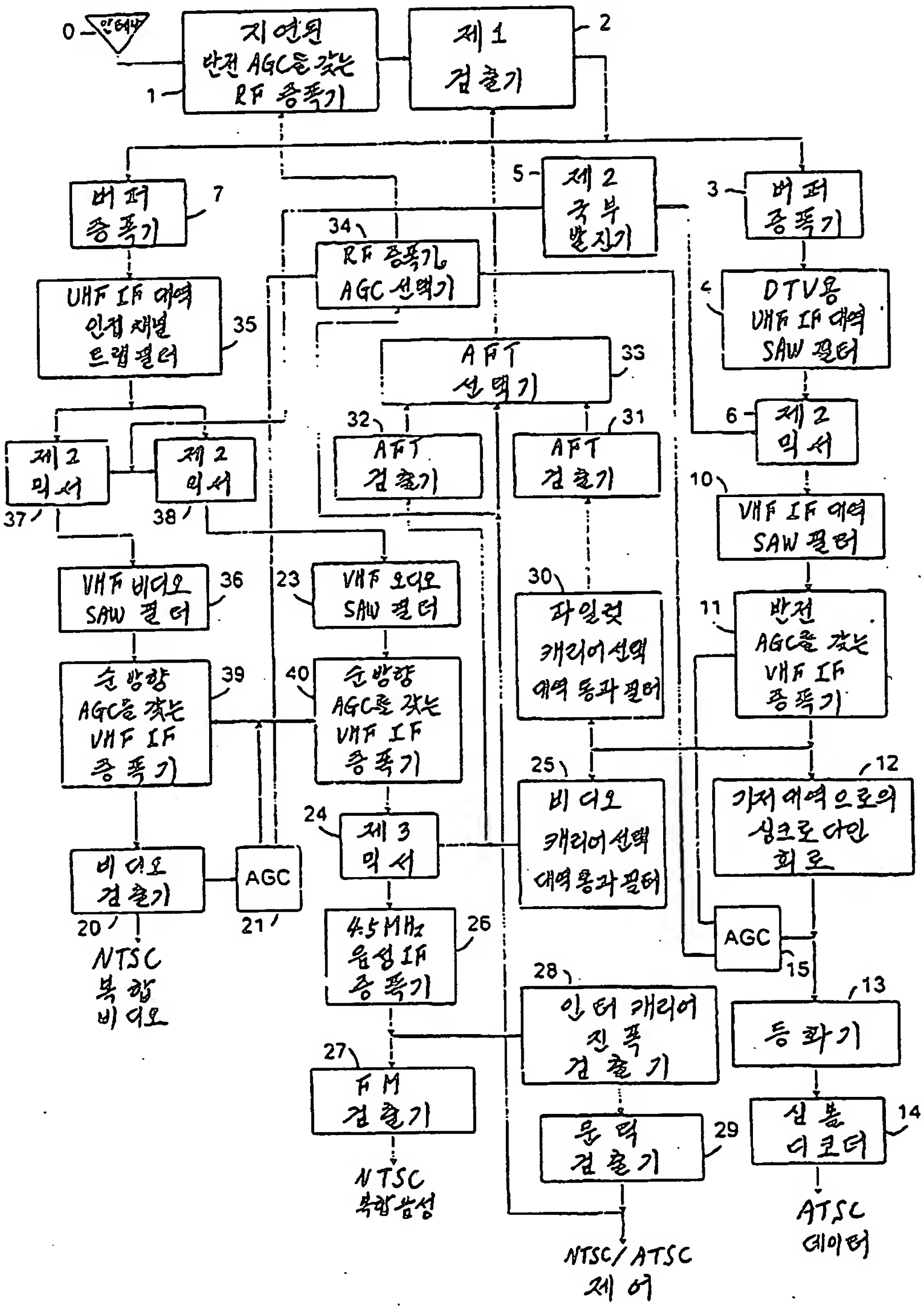
0	Antenna
1	RF amplifier with delayed inverted AGC
2	First detector
3	Buffer amplifier
4	UHF IF band SAW filter for DTV
5	Second local oscillator
6	Second mixer
7	Buffer amplifier
9	Second mixer
10	VHF IF band SAW filter
11	VHF IF amplifier with inverted AGC
12	Synchrodyne circuit to baseband
13	Equalizer
14	Symbol decoder
	ATSC data
16	VHF IF band SAW filter
17	VHF IF amplifier with forward AGC
18	Buffer amplifier
20	Video detector
	NTSC composite video
22	Buffer amplifier
23	VHF audio SAW filter
24	Third mixer
25	Video carrier selection bandpass filter
26	4.5 MHz sound IF amplifier
27	FM detector
	NTSC composite sound
28	Intercarrier amplitude detector
29	Threshold detector
	NTSC/ATSC control
30	Pilot carrier selection bandpass filter
31	AFT detector
32	AFT detector
33	AFT selector
34	RF amplifier, AGC selector
35	Adjacent channel trap filter for UHF IF band
36	VHF video SAW filter



안테나
지연된 반전 AGC를 갖는 RF 증폭기
제 1 검출기
버퍼 증폭기
제 2 국부 발진기
버퍼 증폭기
RF 증폭기, AGC 선택기
DTV용 UHF IF 대역 SAW 필터
VHF IF 대역 인접 채널 트랩 필터
AFT 선택기
제 2 믹서
AFT 검출기
AFT 검출기
제 2 믹서
VHF IF 대역 SAW 필터
VHF IF 대역 SAW 필터
버퍼 증폭기
순방향 AGC를 갖는 VHF IF 증폭기
VHF 오디오 SAW 필터
파일럿 캐리어 선택 대역 통과 필터
반전 AGC를 갖는 VHF IF 증폭기
버퍼 증폭기
비디오 캐리어 선택 대역 통과 필터
기저 대역으로의 싱크로 다인 회로
제 3 믹서
VHF 비디오 SAW 필터
4.5MHz 음성 IF 증폭기
AGC
비디오 검출기
AGC
인터 캐리어 진폭 검출기
등화기
FM 검출기
문턱 검출기
심볼 디코더
NTSC 복합 비디오
NTSC 복합음성
NTSC/ATSC 제어
ATSC 데이터

Figure 3

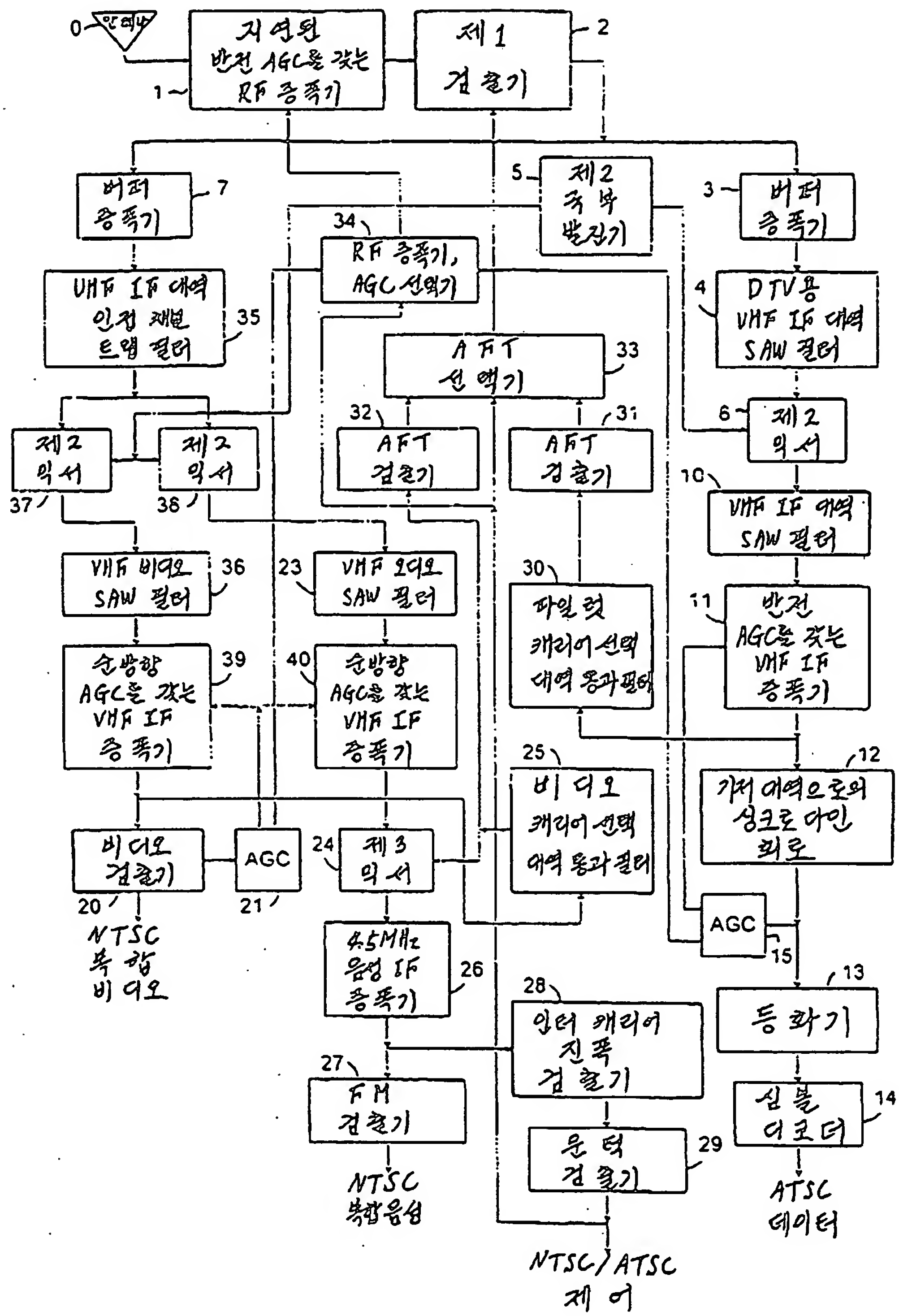
Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	7	Buffer amplifier
	9	Second mixer
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	12	Synchrodyne circuit to baseband
	13	Equalizer
	14	Symbol decoder
		ATSC data
	16	VHF IF band SAW filter
	17	VHF IF amplifier with forward AGC
	18	Buffer amplifier
	20	Video detector
		NTSC composite video
	22	Buffer amplifier
	23	VHF audio SAW filter
	24	Third mixer
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	28	Intercarrier amplitude detector
	29	Threshold detector
		NTSC/ATSC control
	30	Pilot carrier selection bandpass filter
	31	AFT detector
	32	AFT detector
	33	AFT selector
	34	RF amplifier, AGC selector
	35	Adjacent channel trap filter for UHF IF band
	36	VHF video SAW filter



안테나
지연된 반전 AGC를 갖는 RF 증폭기
제 1 검출기
버퍼 증폭기
제 2 국부 발진기
버퍼 증폭기
RF 증폭기 AGC 선택기
UHF IF 대역 인접 채널 트랩필터
DTV용 UHF IF 대역 SAW 필터
AFT 선택기
제 2 믹서
제 2 믹서
AFT 검출기
AFT 검출기
제 2 믹서
VHF IF 대역 SAW 필터
VHF 비디오 SAW 필터
VHF 오디오 SAW 필터
파일럿 캐리어선택 대역 통과 필터
반전 AGC를 갖는 VHF IF 증폭기
순방향 AGC를 갖는 VHF IF 증폭기
순방향 AGC를 갖는 VHF IF 증폭기
제 3 믹서
비디오 캐리어선택 대역통과필터
기저대역으로의 싱크로다인 회로
비디오 검출기
AGC
4.5MHz 음성 IF 증폭기
AGC
NTSC 복합 비디오
인터 캐리어 진폭 검출기
등화기
FM 검출기
문턱 검출기
심볼 디코더
NTSC 복합음성
NTSC/ATSC 제어
ATSC 데이터

Figure 4

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	7	Buffer amplifier
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	12	Synchrodyne circuit to baseband
	13	Equalizer
	14	Symbol decoder
		ATSC data
	20	Video detector
		NTSC composite video
	23	VHF audio SAW filter
	24	Third mixer
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	28	Intercarrier amplitude detector
	29	Threshold detector
		NTSC/ATSC control
	30	Pilot carrier selection bandpass filter
	31	AFT detector
	32	AFT detector
	33	AFT selector
	34	RF amplifier, AGC selector
	35	Adjacent channel trap filter for UHF IF band
	36	VHF audio SAW filter
	37	Second mixer
	38	Second mixer
	39	VHF IF amplifier with forward AGC
	40	VHF IF amplifier with forward AGC



0 안테나
1 지연된 반전 AGC를 갖는 RF 증폭기
2 제1 검출기
7 버퍼 증폭기
5 제2 국부 발진기
3 버퍼 증폭기
34 RF 증폭기, AGC 선택기
35 VHF IF 대역 인접 채널 트랩 필터
4 DTV용 VHF IF 대역 SAW 필터
33 AFT 선택기
32 AFT 검출기
31 AFT 검출기
37 제2 믹서
38 제2 믹서
6 제2 믹서
10 VHF IF 대역 SAW 필터
36 VHF 비디오 SAW 필터
23 VHF 오디오 SAW 필터
30 파일럿 캐리어 선택 대역 통과 필터
11 반전 AGC를 갖는 VHF IF 증폭기
39 순방향 AGC를 갖는 VHF IF 증폭기
40 순방향 AGC를 갖는 VHF IF 증폭기
25 비디오 캐리어 선택 대역 통과 필터
12 기저 대역으로의 싱크로 다인 회로
20 비디오 검출기
21 AGC
24 제3 믹서
15 AGC
NTSC 복합 비디오
26 4.5MHz 음성 IF 증폭기
28 인터 캐리어 진폭 검출기
13 등화기
27 FM 검출기
29 문턱 검출기
14 심볼 디코더
NTSC 복합음성
ATSC 데이터
NTSC/ATSC 제어

Figure 5

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	7	Buffer amplifier
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	12	Synchrodyne circuit to baseband
	13	Equalizer
	14	Symbol decoder
		ATSC data
	20	Video detector
		NTSC composite video
	23	VHF audio SAW filter
	24	Third mixer
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	28	Intercarrier amplitude detector
	29	Threshold detector
		NTSC/ATSC control
	30	Pilot carrier selection bandpass filter
	31	AFT detector
	32	AFT detector
	33	AFT selector
	34	RF amplifier, AGC selector
	35	Adjacent channel trap filter for UHF IF band
	36	VHF audio SAW filter
	37	Second mixer
	38	Second mixer
	39	VHF IF amplifier with forward AGC
	40	VHF IF amplifier with forward AGC

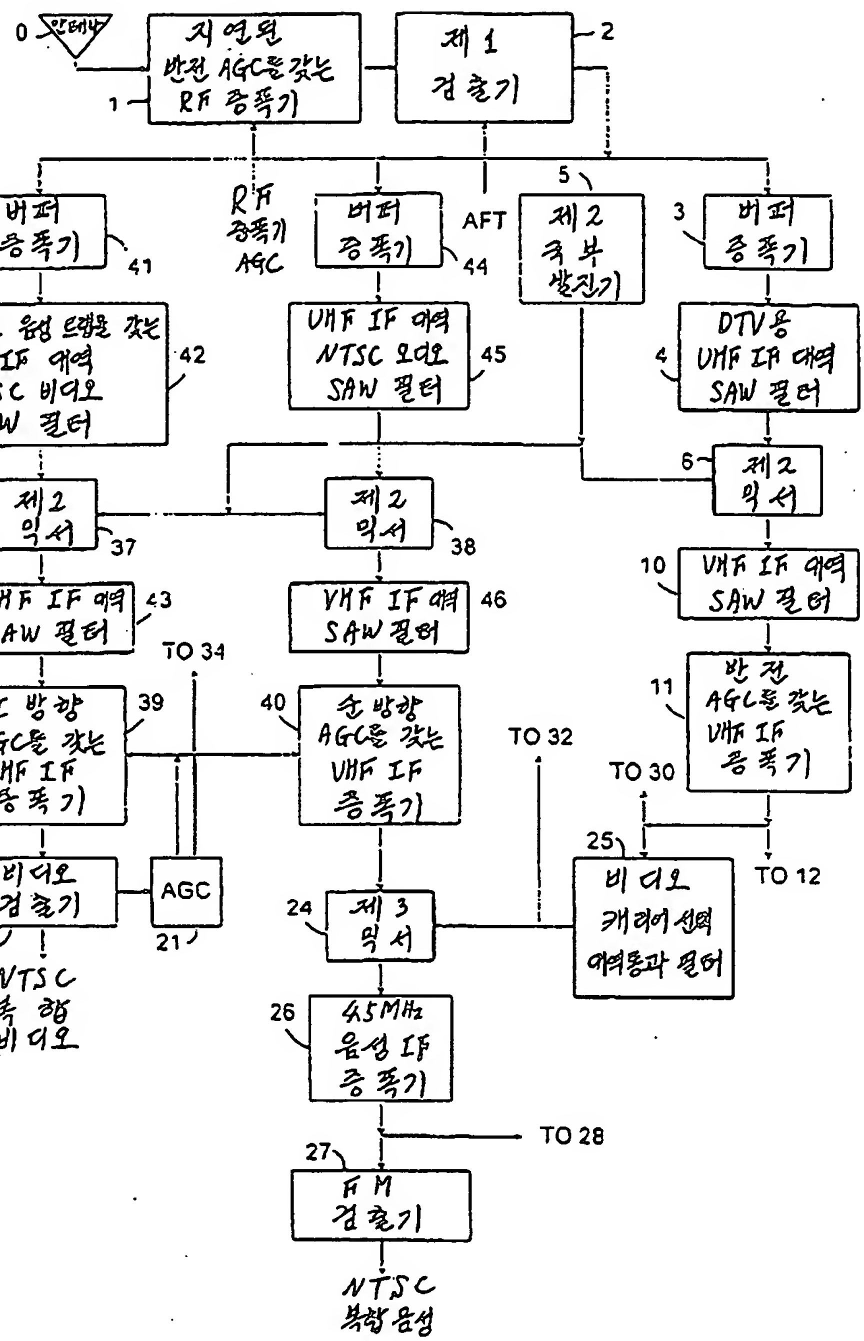

안테나
0
지연된 반전 AGC를 갖는 RF 증폭기
1
제 1 검출기
2
RF 증폭기 AGC
AFT
5
버퍼 증폭기
41
버퍼 증폭기
44
제 2 국부 발진기
3
버퍼 증폭기
인-채널 음성 트랩을 갖는 UHF IF 대역 NTSC 비디오 SAW 필터
42
UHF IF 대역 NTSC 오디오 SAW 필터
45
4
DTV용 UHF IF 대역 SAW 필터
6
제 2 믹서
제 2 믹서
37
제 2 믹서
38
10
VHF IF 대역 SAW 필터
VHF IF 대역 SAW 필터
43
VHF IF 대역 SAW 필터
46
TO 34
11
반전 AGC를 갖는 VHF IF 증폭기
순방향 AGC를 갖는 VHF IF 증폭기
39
40
순방향 AGC를 갖는 VHF IF 증폭기
TO 32
TO 30
25
TO 12
비디오 검출기
AGC
24
제 3 믹서
비디오 캐리어 선택 대역통과 필터
20
21
NTSC 복합 비디오
26
4.5MHz 음성 IF 증폭기
TO 28
27
FM 검출기
NTSC 복합 음성

Figure 6

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
		RF amplifier AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	20	Video detector
		NTSC composite video
	24	Third mixer
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	37	Second mixer
	38	Second mixer
	39	VHF IF amplifier with forward AGC
	40	VHF IF amplifier with forward AGC
	41	Buffer amplifier
	42	UHF IF band NTSC video SAW filter with in-channel sound trap
	43	VHF IF band SAW filter
	44	Buffer amplifier
	45	UHF IF NTSC audio SAW filter
	46	VHF IF band SAW filter

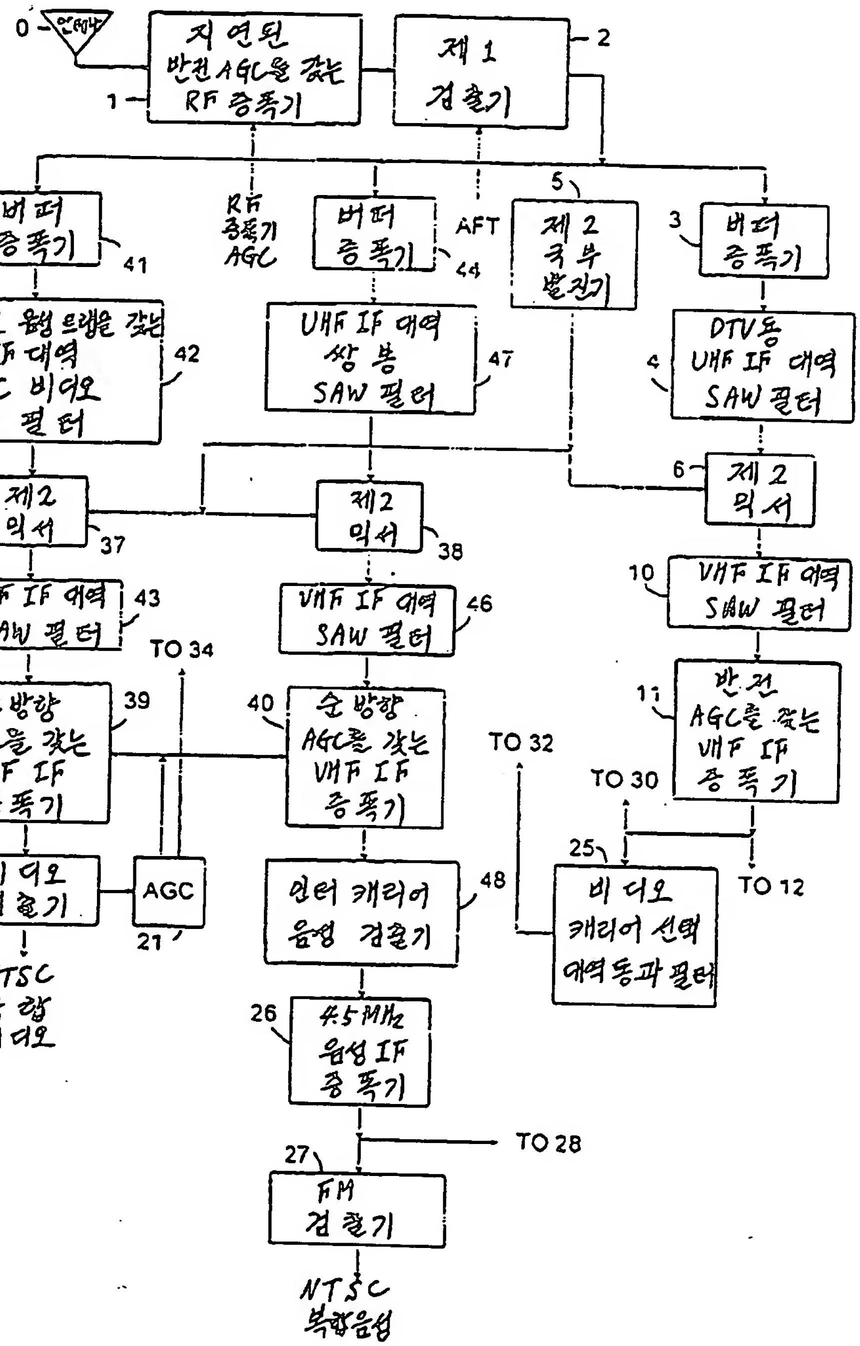

안테나
지연된 반전 AGC을 갖는 RF 증폭기
제 1 검출기
버퍼 증폭기
RF 증폭기 AGC
AFT
제 2 국부 발진기
인-채널 음성 트랩을 갖는 UHF IF 대역 NTSC 비디오 SAW 필터
UHF IF 대역 쌍 봉 SAW 필터
DTV용 UHF IF 대역 SAW 필터
제2 믹서
VHF IF 대역 SAW 필터
TO 34
순 방향 AGC을 갖는 VHF IF 증폭기
반전 AGC를 갖는 VHF IF 증폭기
TO 32
TO 30
TO 12
비디오 검출기
AGC
인터 캐리어 음성 검출기
비디오 캐리어 선택 대역통과 필터
NTSC 복합 비디오
4.5MHz 음성 IF 증폭기
TO 28
FM 검출기
NTSC 복합음성
0
1
2
3
4
5
6
10
11
20
21
25
26
27
37
38
39
40
41
42
43
44
46
47
48

Figure 7

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
		RF amplifier AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	20	Video detector
		NTSC composite video
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	37	Second mixer
	38	Second mixer
	39	VHF IF amplifier with forward AGC
	40	VHF IF amplifier with forward AGC
	41	Buffer amplifier
	42	UHF IF band NTSC video SAW filter with in-channel sound trap
	43	VHF IF band SAW filter
	44	Buffer amplifier
	46	VHF IF band SAW filter
	47	UHF IF band double-humped SAW filter
	48	Intercarrier sound detector

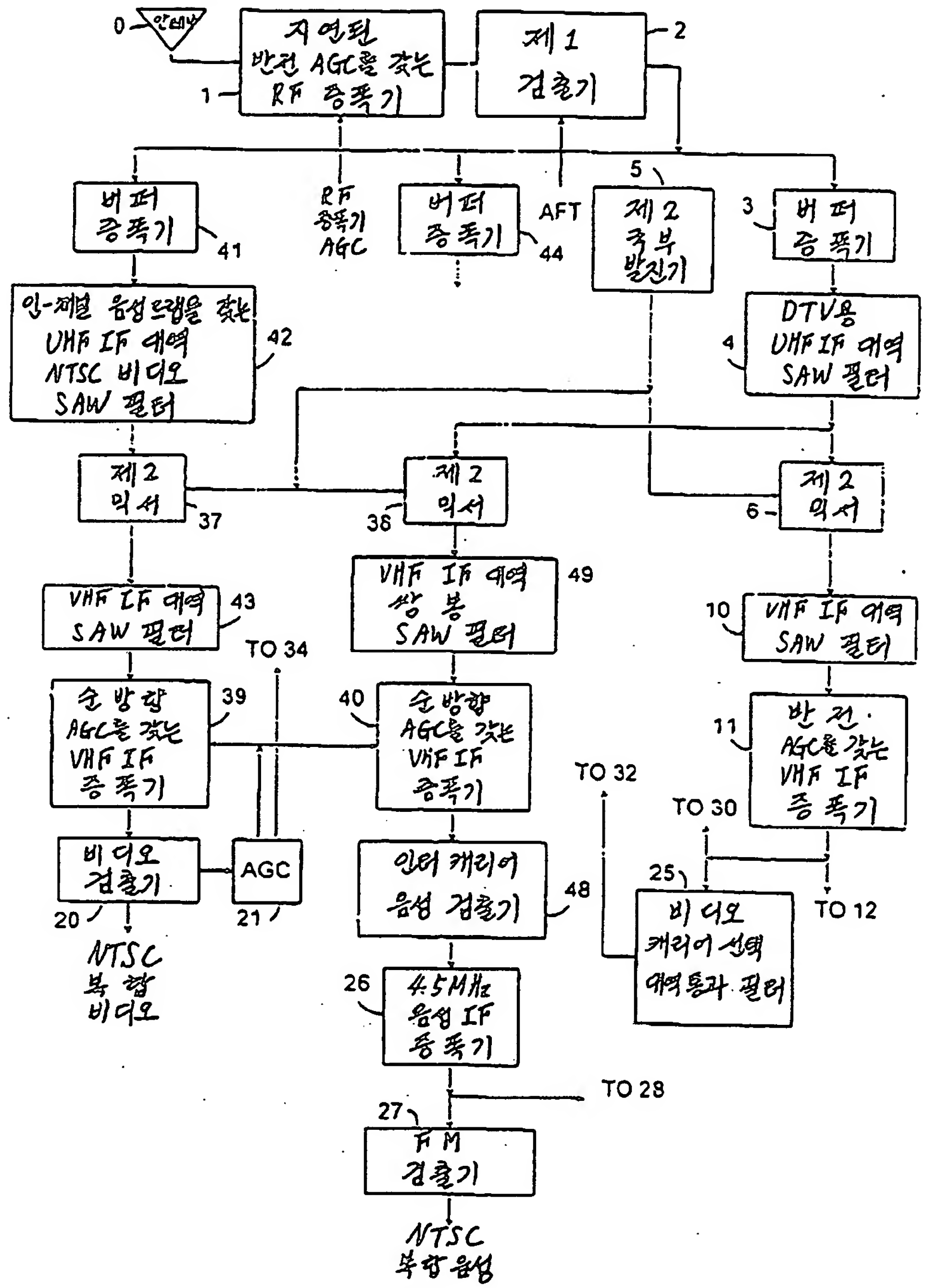

0
안테나
지연된 반전 AGC를 갖는 RF 증폭기
1
제 1 검출기
2
버퍼 증폭기
41
RF 증폭기 AGC
버퍼 증폭기
44
AFT
5
제 2 국부 발진기
3
버퍼 증폭기
인-채널 음성트랩을 갖는 UHF IF 대역 NTSC 비디오 SAW 필터
42
DTV용 UHF IF 대역 SAW 필터
4
제 2 믹서
37
제 2 믹서
38
제 2 믹서
6
VHF IF 대역 SAW 필터
43
VHF IF 대역 쌍봉 SAW 필터
49
10
VHF IF 대역 SAW 필터
TO 34
순방향 AGC를 갖는 VHF IF 증폭기
39
40
순방향 AGC를 갖는 VHF IF 증폭기
11
반전 AGC를 갖는 VHF IF 증폭기
TO 32
TO 30
비디오 검출기
AGC
20
21
NTSC 복합 비디오
인터 캐리어 음성 검출기
48
25
비디오 캐리어 선택 대역통과 필터
TO 12
26
4.5MHz 음성 IF 증폭기
TO 28
27
FM 검출기
NTSC 복합음성

Figure 8

Key:	0	Antenna
	1	RF amplifier with delayed inverted AGC
		RF amplifier AGC
	2	First detector
	3	Buffer amplifier
	4	UHF IF band SAW filter for DTV
	5	Second local oscillator
	6	Second mixer
	10	VHF IF band SAW filter
	11	VHF IF amplifier with inverted AGC
	20	Video detector
		NTSC composite video
	21	AGC
	25	Video carrier selection bandpass filter
	26	4.5 MHz sound IF amplifier
	27	FM detector
		NTSC composite sound
	37	Second mixer
	38	Second mixer
	39	VHF IF amplifier with forward AGC
	40	VHF IF amplifier with forward AGC
	41	Buffer amplifier
	42	UHF IF band NTSC video SAW filter with in-channel sound trap
	43	VHF IF band SAW filter
	44	Buffer amplifier
	48	Intercarrier sound detector
	49	VHF IF band double-humped SAW filter

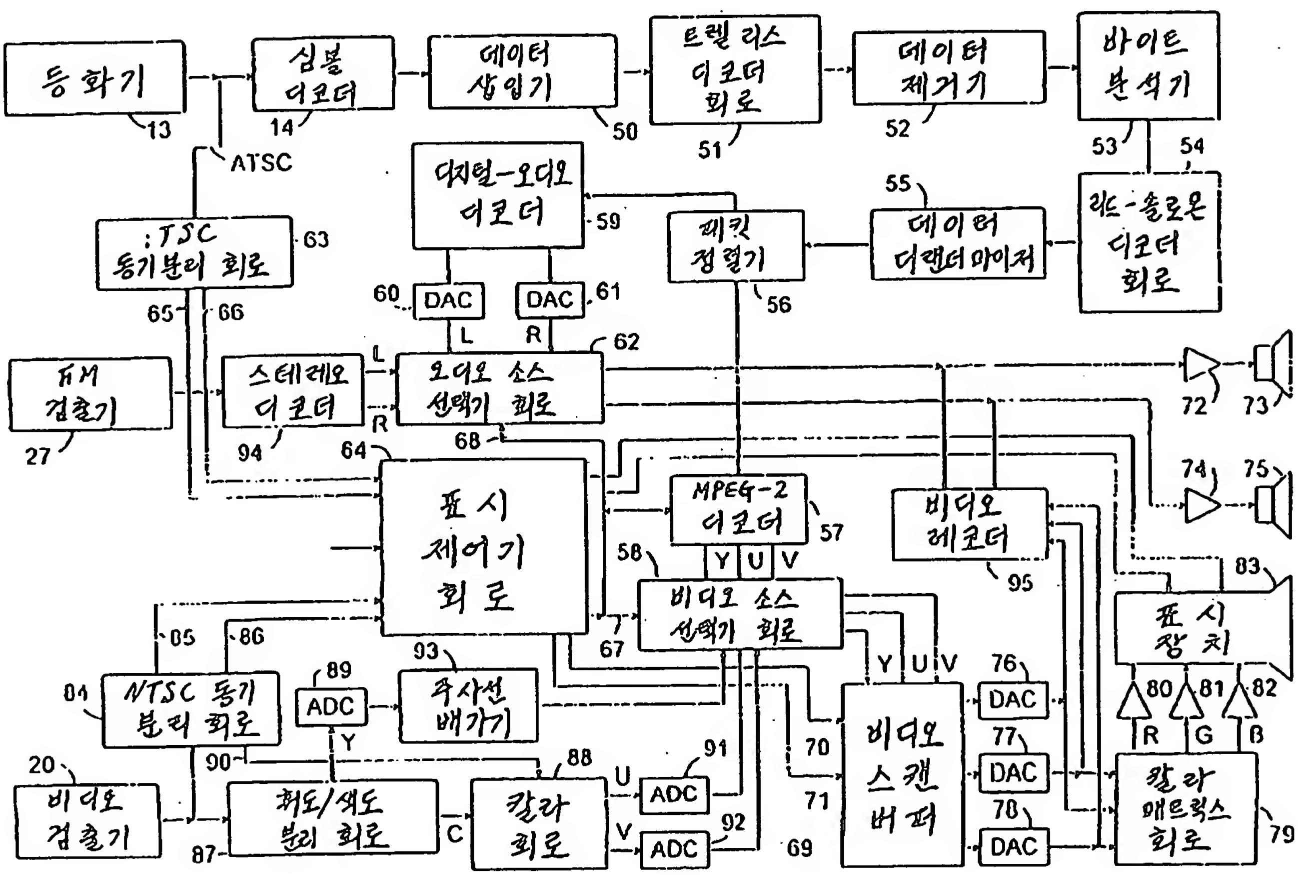

등화기
심볼 디코더
데이터 삽입기
트렐리스 디코더 회로
데이터 제거기
바이트 분석기
ATSC
디지털-오디오 디코더
패킷 정렬기
데이터 디랜더마이저
리드-솔로몬 디코더 회로
:TSC 동기분리 회로
DAC
DAC
L
R
FM 검출기
스테레오 디코더
오디오 소스 선택기 회로
표시 제어기 회로
MPEG-2 디코더
Y
U
V
비디오 레코더
비디오 소스 선택기 회로
표시 장치
NTSC 동기 분리 회로
ADC
주사선 배가기
비디오 스캔 버퍼
DAC
DAC
DAC
R
G
B
비디오 검출기
휘도/색도 분리 회로
C
칼라 회로
ADC
ADC
칼라 매트릭스 회로
13
14
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
20
27

Figure 9

Key:	13	Equalizer
	14	Symbol decoder
	20	Video detector
	27	FM detector
	50	Data inserter
	51	Trellis decoder circuit
	52	Data rejecter
	53	Byte analyzer
	54	Reed-Solomon decoder circuit
	55	Data randomizer
	56	Packet sequencer
	57	MPEG-2 decoder
	58	Video source selector circuit
	59	Digital-audio decoder
	60	DAC
	61	DAC
	62	Audio source selector circuit
	63	JSC synchronizing selection circuit
	64	Display controller circuit
	69	Video scan buffer
	76	DAC
	77	DAC
	78	DAC
	79	Color matrix circuit
	83	Display device
	84	NTSC synchronizing separation circuit
	87	Brightness/chromaticity separation circuit
	88	Color circuit
	89	ADC
	91	ADC
	92	ADC
	93	Scanning line doubler
	94	Stereo decode
	95	Video recorder